Chapter 3
LOCAL OPERATION

Contents

Introduction

This chapter introduces you to your instrument's controls and connectors. It then takes you through a simple set-up exercise to provide some familiarity with operating the instrument from the front panel, followed by detailed instructions.

For remote operation, programming using the built-in GPIB interface is covered in Chapter 4.

How to use the manual

Conventions

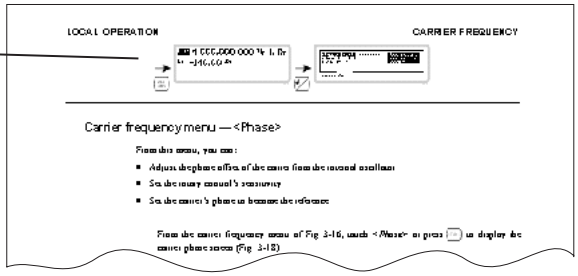
The following conventions are used in this manual:

RF OUTPUT	Markings on the instrument are shown in capitals.
SIG GEN	Hard keys are shown like this.
RF Level	Text that appears on the screen is shown in italics.
<FM>	Soft tabs, which appear at the foot of the screen, are shown in brackets and italics.
AM1	Touch-sensitive areas appear as they do on the screen.

***Note**: representations of the instrument's screen are shown as inverted video (that is, as black text on a white background) in this manual.*

Headers

Small graphics in the header supplement the text by giving an 'at a glance' reminder of the path by which you arrived at the functions on that page.



References to remote operation commands

Where relevant, each individual function is shown with its corresponding remote operation command and a reference to the relevant page for details.

For example:

■*Carr Freq* *FREQ* page 4-32

Index

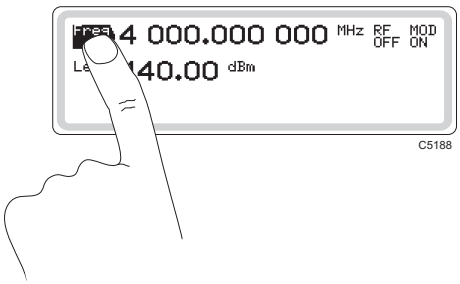
There is a comprehensive index at the end of the manual.

Controls, connectors and display

You select a function initially by touching the display screen. The chosen 'function label' (see box) is highlighted. Alternatively, you can use the ↑ and ↓ keys to move around the screen.

You select parameters using the keyboard keys (which have their functions printed on them), the numeric keypad or the control knob.

The numeric keys are used to set parameters to specific values, which can also be varied in steps of any size by using the ×10 and ÷10 keys or the control knob.



The screen can display three different types of touch area.

Function labels look like this Freq ... and reveal further sub-menus once you touch them.

Soft boxes look like this 1 Int AM1 and when touched, expand to reveal summarized information about the named function.

Soft tabs appear at the foot of the screen and reveal further parameters once you touch them.

See page 3-12.

Connectors and standby/on switch

Front-panel connectors and the standby/on switch are shown in Fig. 3-1 below.

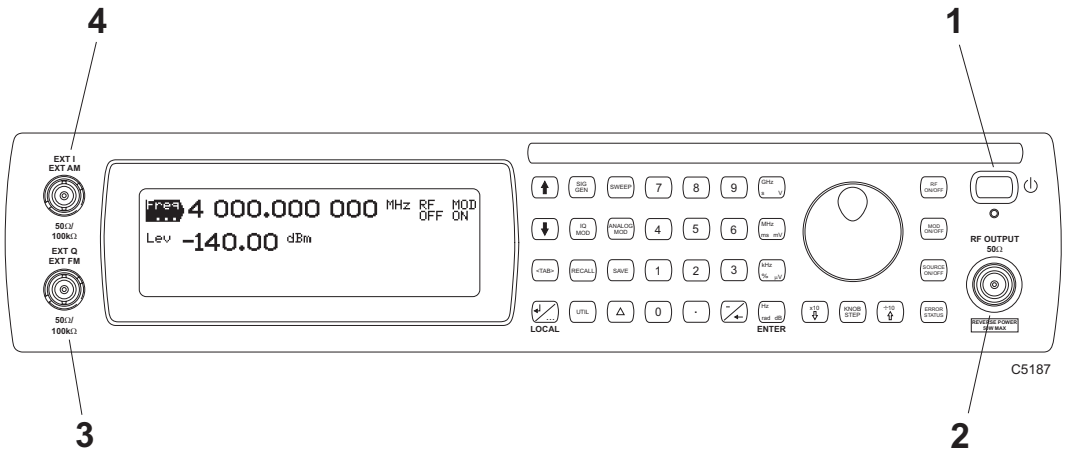


Fig. 3-1 Front panel

1	Standby/on switch	Switches the instrument between the on and standby modes, using a press on, press off action. To prevent accidental operation, this switch has a built-in time delay of about half a second before it is recognized. The adjacent LED is amber during standby, showing that power is applied to the crystal oscillator. The LED turns green when the instrument is fully powered up. Use the power supply switch on the rear panel (page 3-9) to isolate the instrument from AC line power.
2	RF OUTPUT	50 Ω N-type socket. Protected against the application of reverse power of up to 50 W (to 3 GHz) or 25 W (to 4 GHz) from a 50 Ω source. Protection remains active when AC line power is removed from the instrument. Option 7 locates this socket on the rear panel.
3	EXT Q / EXT FM	Q input. External frequency modulation input. BNC socket, selectable 50 Ω/100 kΩ. Option 7 locates this socket on the rear panel and the front-panel marking becomes Q/FM OUTPUT.
4	EXT I / EXT AM	I input. External amplitude modulation input. BNC socket, selectable 50 Ω/100 kΩ. Option 7 locates this socket on the rear panel and the front-panel marking becomes I/AM OUTPUT.

Keyboard

The keyboard is functionally color-coded:

- Keys for navigating around the screen are light blue
- Keys associated with numeric entry are light gray
- Remaining keys are darker gray.

Fig. 3-2 identifies all the items on the keyboard.

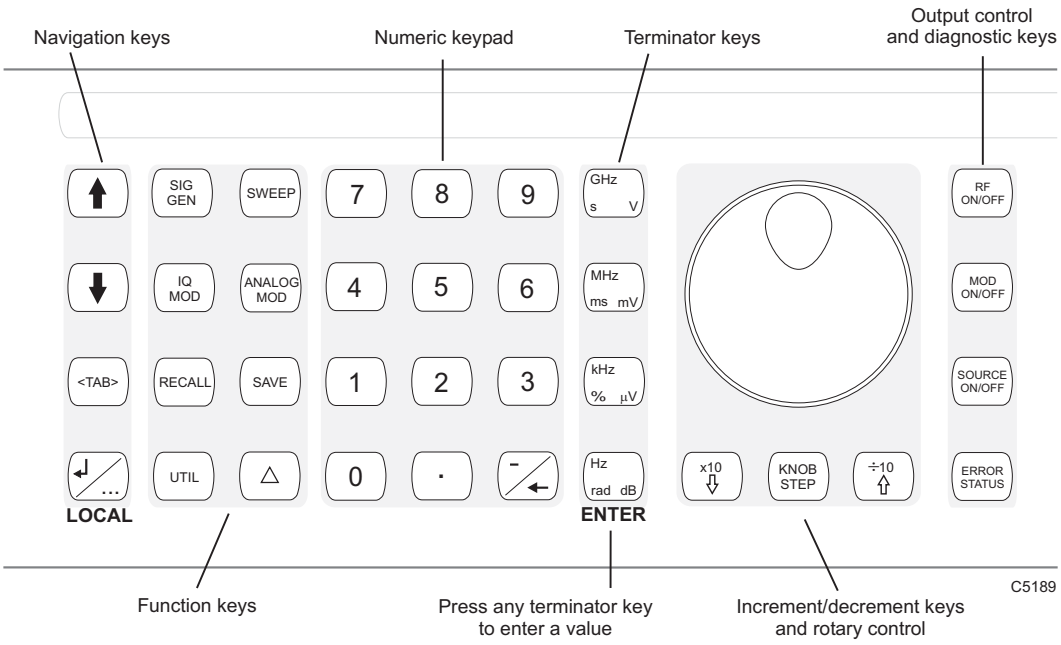


Fig. 3-2 Keyboard

Navigation keys

↑	Scrolls backwards through a menu list or selects the previous main-screen function.
↓	Scrolls forwards through a menu list or selects the next main-screen function.
<TAB>	Selects the next 'soft tab'. With the main screen displayed, scrolls through the modulation summary list.
↵/…	Enters/exits a function's sub-menu.
LOCAL	Transfers control from remote operation to front-panel operation (local lockout not asserted).

Function keys

SIG GEN	Displays the main signal generator menu.
SWEEP	Displays the sweep menu.
IQ MOD	Displays the IQ modulation setup menu.
ANALOG MOD	Displays the analog modulation setup menu.
RECALL	Recalls a previously stored instrument setting from memory.
SAVE	Saves the current instrument settings in memory.
UTIL	Displays the utilities menu.
△	Displays the total shift/increment menu. Use this to: inspect the total shift from the last keyed-in value change the step size transfer the current value as the keyed-in value return the setting to the last keyed-in value.

Numeric keypad

For entering the value of a selected parameter.

Terminator keys

- / ←	Minus sign/backspace key: enters a minus sign or deletes the last character input.
Units keys	Determine the units of the set parameters; also, any one of these four keys is used to terminate a numeric entry or confirm a selection.
ENTER	

Increment/decrement keys and rotary control

Control knob — When enabled by the [KNOB/STEP] key, adjusts the value of the selected parameter.

When KNOB is enabled, increases the knob resolution by a factor of 10.

When STEP is enabled, increments the current function by one step.

Switches between enabling the control knob and step operation.

When KNOB is enabled, decreases the knob resolution by a factor of 10.

When STEP is enabled, decrements the current function by one step.

Output control and diagnostic keys

Toggles the RF output on and off.

Toggles all modulation on and off, overriding any individual modulation paths currently selected. *MOD ON* or *MOD OFF* is displayed on the main screen.

Toggles the current modulation path on and off.

Displays the error status menu, which provides additional diagnostic information.

Rear-panel connectors

The rear-panel connectors are shown in Fig. 3-3 below.

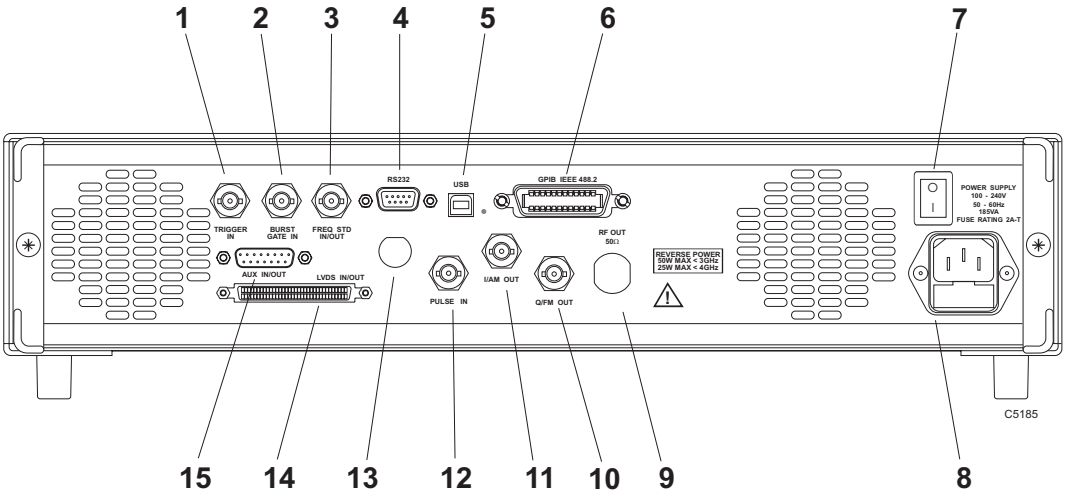


Fig. 3-3 Rear panel

1	TRIGGER IN	50 Ω BNC socket (TTL): accepts a sweep trigger input. Pull-up resistor.
2	BURST GATE IN	50 Ω BNC socket (TTL): a burst control signal triggers analog ramp-up or ramp-down of RF level. If generated internally by the ARB, the burst control signal is output from this connector.
3	FREQ STD IN/OUT	BNC socket, 300 mV to 1.8 V RMS into 1 kΩ: for the input of external standard frequencies of either 1 MHz or 10 MHz. Can also supply a 2 V p-p 10 MHz internal standard output from 50 Ω.
4	RS232	9-way RS-232 connector for remote operation and downloading software upgrades. For contact allocation see Chapter 2.
5	USB	Not currently supported by software.
6	IEEE 488.2	24-pin socket accepts the standard GPIB connector to allow remote operation of the instrument.
7	Power supply switch	Isolates the instrument from the AC line power supply.
8	Power supply receptacle	3-pin plug integral with fuse holder.
9	RF OUTPUT (Option 7)	Replaces the front-panel 50 Ω N-type socket.
10	Q/FM OUT	50 Ω BNC socket, 1 V RMS: outputs the Q signal from the ARB or the output of the FM source.
11	I/AM OUT	50 Ω BNC socket, 1 V RMS: outputs the I signal from the ARB or the output of the AM source.
12	PULSE IN	50Ω BNC socket: accepts a pulsed input. TTL logic '1' (2 to 5 V) turns the carrier on, logic '0' (0 to 0.8 V) turns it off. Maximum input is ±10 V.
13		Not currently supported
14	LVDS IN/OUT	Not currently supported
15	AUX IN/OUT	Not currently supported

GETTING STARTED

Switching on

- Check that no external signal sources are connected.
- Switch on the power on/off switch on the rear panel.

This supplies power to the instrument, which is now in standby mode (the LED on the front panel lights up amber).

- Press the supply switch on the front panel until the LED lights up green and the instrument powers up.

The instrument displays a welcome screen, followed by a screen of instrument details (instrument and software version), a self-test, and then the main SIG GEN screen. Fig. 3-4 shows the main screen as it first appears during normal operation. (The default maximum frequency shown is 2, 3 or 4 GHz, depending on your instrument.)

Fig. 3-4 Main screen, showing default display

Your screen doesn't look like this?

If a main screen similar to that shown in Fig. 3-4 does not appear, a previous user may have configured the instrument to recall one of the user memories at power-on, rather than using the factory default settings.

To reset to the factory default settings, follow the procedure on page 3-91 or use the 'Quick preset' shown here.

This procedure does not change the power-on settings, so there is no danger of disrupting the previous user's set-up!

Quick preset

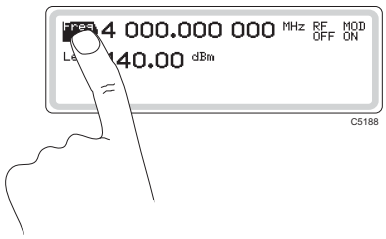
1. Press the UTIL key to display the utilities screen.
2. Use the ↓ and ↑ keys to highlight ▪*System*.
3. Display the power-on status screen by entering **4** on the numeric keypad (press **4**, then one of the four ENTER keys).
4. Touch the <*Preset*> tab at the bottom of the screen.
5. Touch the 0 Preset Instrument soft box, followed by an ENTER key again.
6. The instrument's hardware configuration immediately changes to the factory default settings (page 3-112).

How to select functions

Whilst we believe that you will find the instrument's touch screen easy and efficient to use, there are also simple keyboard equivalents for each operation. These are mentioned in the text, where relevant.

Main functions

Touch the function label on the screen — for example, Freq ... . The label is highlighted, showing that the function is active.



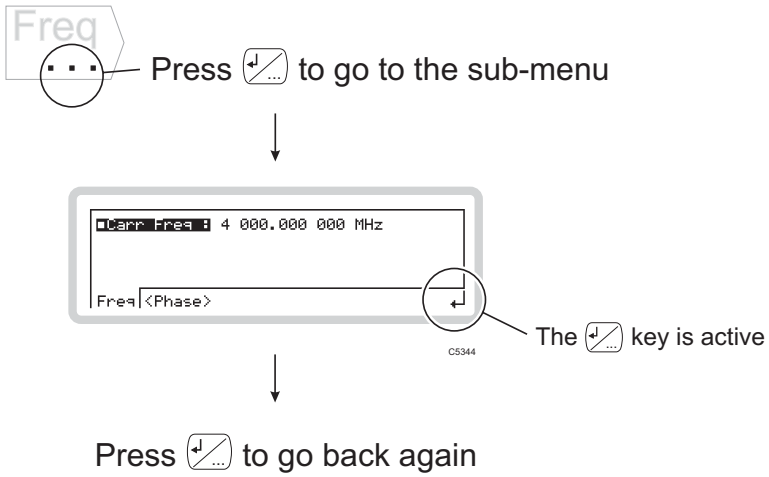
When the label of a main function — carrier frequency, RF level, modulation, modulation path — is highlighted on the screen, you can change the displayed value by simply entering a new value. Terminate the entry with the appropriate ENTER key.

Keyboard control: use ↓ and ↑ to move the highlighting up and down the screen.

Sub-menus

The three dots on a highlighted function label — for example, Freq ... — show that a sub-menu exists for that function, giving you access to further parameters.

Press ↵... to see the sub-menu, and to return again. A '↵' symbol appears in the corner of the display to show that this key is active.

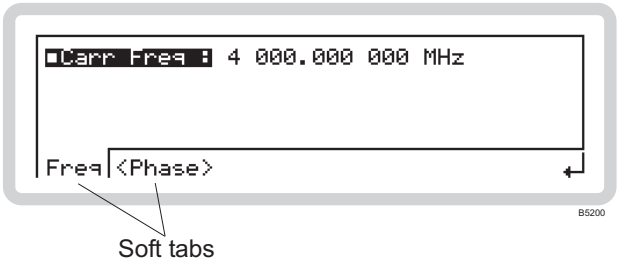


You may see three dots instead of the '↵' symbol when setting up the modulation mode.

Soft tabs

Soft tabs appear at the bottom of the screen.

Touch these to select them, or use <TAB> to scroll through them.



Soft boxes

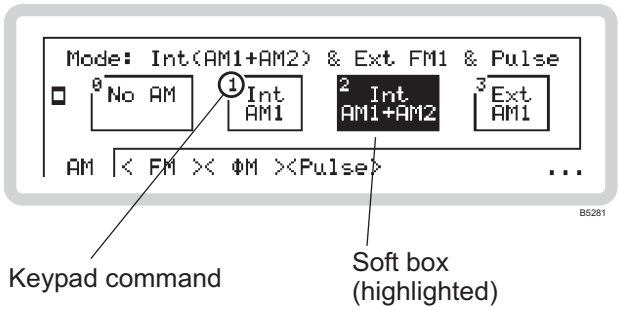
Soft boxes can appear anywhere on the screen. Mostly, they allow you to control operations (for example, sweeping) or provide choices of configurations (for example, between different sorts of modulation).

To select a soft box:

- Touch it

or

- enter, on the numeric keypad, the number shown in the corner of the soft box — the **keypad command**.



For example…

To help you quickly become familiar with the basic operation of the instrument, try the following exercise, which demonstrates how to set up a typical signal with these parameters:

Carrier frequency:	100 MHz
Output level:	–10 dBm
Frequency modulation:	100 kHz deviation at 500 Hz modulation.

Once you have done this exercise once, you are unlikely to need it again — the instrument is very intuitive to use!

The starting point

Press [SIG GEN] to see the main screen. Use this key at any time to view the current status of the instrument.

Fig. 3-5 Main screen

Setting the carrier frequency

1 Touch [Freq] to select carrier frequency as the current function.

2 Use the numeric keypad to enter 100 MHz, by:

keying in **100**

and terminating with the [MHz ms mV] key.

3 The frequency displayed changes to *100.000 000 MHz*.

Error message

If an error number (for example, *Err 100*) is displayed, it can be canceled by a correct entry (for example, by entering a value that is within limits).

A complete list of error messages starts on page 3-113.

Backspace key

If you make a mistake when keying in, press the backspace key [←] and re-enter the correct value.

You can also clear the entire entry by reselecting the function.

Setting RF level

1 Touch [Lev] to select RF level as the current function.

2 Use the numeric keypad to enter −10 dBm, by:

pressing [+/-]

keying in **10**

and terminating with the [Hz rad dB] key.

3 The RF level displayed changes to *−10.0 dBm*.

4 Pressing [RF ON/OFF] toggles between the RF output on and off, as shown by *RF ON* and *RF OFF* on the screen. Select *RF ON*.

A 100 MHz, −10 dBm RF carrier now appears at the RF OUTPUT socket.

Setting analog modulation

1 Press [ANALOG MOD], which displays the modulation mode screen.

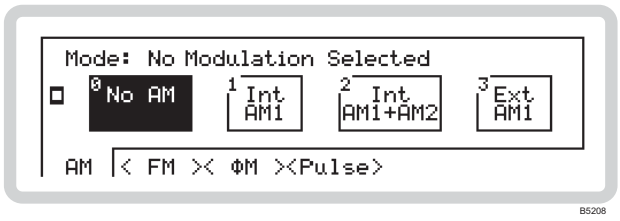


Fig. 3-6 AM modes

2 Touch the <*FM*> soft tab to display the available FM modulation modes.

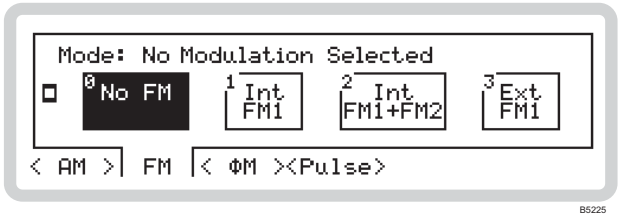


Fig. 3-7 FM modes

3 Touch [1 Int FM1] to select a single internal FM path.

4 Press [SIG GEN] to see the selected modulation mode.

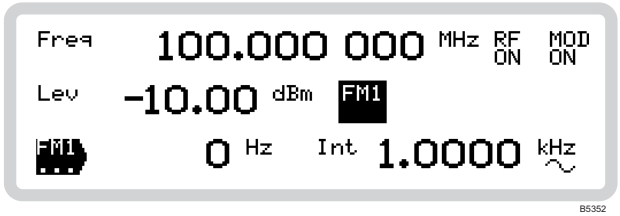


Fig. 3-8 The main screen with FM selected

5 Touch [FM1] and press [↵], which takes you to the sub-menu to set up the FM path. The modulation deviation field is highlighted.

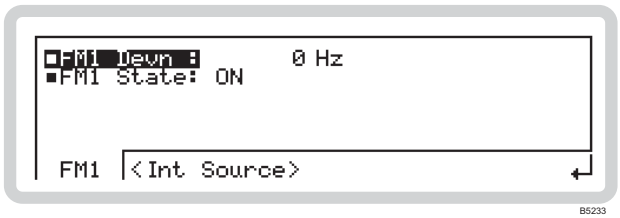


Fig. 3-9 FM1 sub-menu — deviation

6 Use the numeric keypad to enter 100 kHz, by:

keying in **100**

and terminating with the [kHz % µV] key.

7 The FM1 deviation displayed changes to *100 kHz*.

8 Press [↓] to move down one line on the screen.

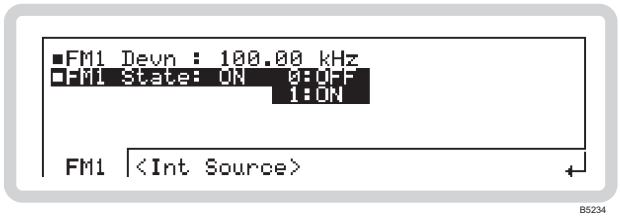


Fig. 3-10 FM1 sub-menu — state

9 Press **1** on the numeric keypad to switch ON the FM path (it should already be on by default, unless the instrument's power-up parameters have been changed).

10 Touch the *<Int Source>* soft tab. This displays the sub-menu to set up the internal modulation path, with the frequency field *Int Freq* highlighted.

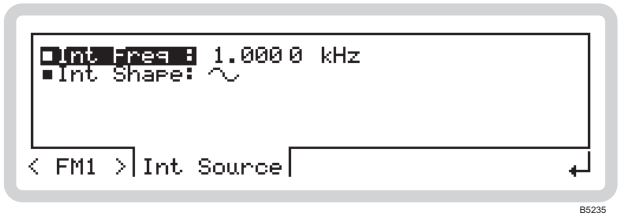


Fig. 3-11 FM1 sub-menu — internal path frequency

11 Use the numeric keypad to enter 500 Hz, by:

keying in **500**

and terminating with the [Hz rad dB] key.

The modulation frequency displayed changes to *500 Hz*.

12 Press ↓ to move down one line on the screen.

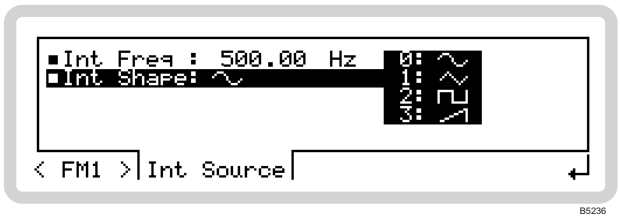


Fig. 3-12 FM1 sub-menu — internal path shape

13 Press **0** on the numeric keypad to select a sine wave (it should already be selected by default, unless the instrument's power-up parameters have been changed).

14 Press SIG GEN to see this summarized on the main screen.

15 Pressing SOURCE ON/OFF toggles the modulation source on and off, as shown by FM1 and FM1 OFF on the screen. Turn the modulation source on.

Fig. 3-13 The main screen, FM source on

16 Turn the overall modulation on by pressing MOD ON/OFF (it should already be selected by default, unless the instrument's power-up parameters have been changed).

Fig. 3-14 The fully set-up main screen, modulation and RF output on

A 100 MHz, −10 dBm carrier, with 100 kHz deviation, modulated at 500 Hz, now appears at the RF OUTPUT socket.

Using the [x10] and [÷10] keys

When you have entered a value using the numeric keypad, you can adjust its value either in single or continuous steps.

As an example, we shall adjust the carrier frequency using the rotary control for continuous adjustment as well as in selected increments/decrements using single steps.

Touch [Freq ...] to select carrier frequency as the current function. The frequency is displayed as *100.000 000 MHz*. The number of digits behind the decimal point shows the maximum resolution: the frequency can be changed in 1 Hz steps.

Using rotary control

1 Select rotary control adjustment by toggling the [KNOB/STEP] key so that a bracket underlines the carrier frequency. With the bracket displayed, the control knob is enabled and its sensitivity can be set.

2 Adjust rotary control sensitivity by pressing either the [x10] key or the [÷10] key. Pressing the [÷10] key increases the length of the bracket by one decimal place. Pressing the [x10] key shortens the length by one decimal place. In this way, rotary control resolution decreases or increases by a factor of ten.

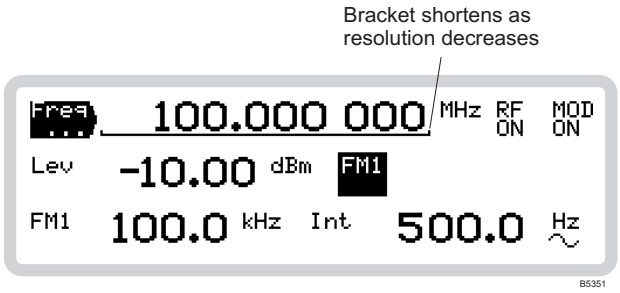


Fig. 3-15 Resolution of the rotary control

3 Move the control knob in either direction and note how the displayed carrier frequency changes by the desired amount.

4 To check the current amount of offset from the reference carrier frequency, press [△]. The offset is displayed as either a negative or positive value.

5 Press [SIG GEN] to return to the main screen.

Using steps

1 Press KNOB/STEP to disable the rotary control adjustment (the bracket under the carrier frequency disappears).

2 Press △. Scroll down to *Increment* using the ↓ navigation key. Enter the size of frequency step using the numeric keypad, and terminate with the [MHz], [kHz] or [Hz] key. The instrument now uses this new value of step size.

3 Press SIG GEN to return to the main screen.

4 Now press the ×10 ⇩ and ÷10 ⇧ keys repeatedly and note how the displayed carrier frequency changes in steps of the increment that you have just set. Holding either of these keys pressed provides continuous stepping.

5 In the same way as for rotary control operation, you can check the current amount of offset from the reference carrier frequency by pressing △.

And that's about it!

These few pages have shown you the fundamentals of operating the instrument — which apply throughout the manual. We hope and believe that you will find operation intuitive and simple.

If you need help, just refer back to these pages or to the quick reference on page 3-107.

DETAILED OPERATION

Carrier frequency and RF level

Press SIG GEN to see the main screen (Fig. 3-16), from which you can set up parameters associated with the instrument's carrier frequency and RF level.

Fig. 3-16 Main screen

Set **carrier frequency** or **RF level** directly:

1 Touch the relevant function label on the screen (Freq or Lev).

2 Enter the value using the numeric keypad. Terminate using the appropriate units key.

3 You can adjust the value displayed, either in steps or by using the rotary control for continuous adjustment.

Carrier frequency menu — <Freq>

Use this menu to set the carrier frequency.

1 Touch Freq to select the carrier frequency menu.

2 Press ↵ to view the sub-menus. *Carr Freq* is highlighted (Fig. 3-17).

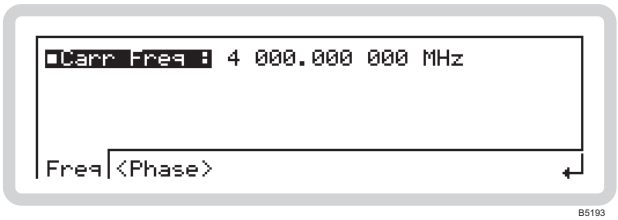
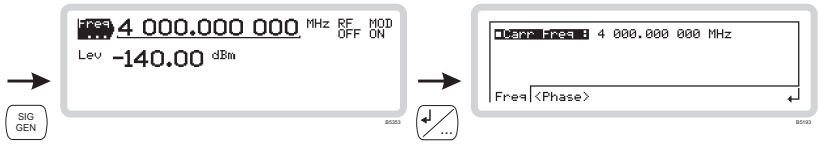


Fig. 3-17 Carrier frequency sub-menu



■*Carr Freq*

FREQ page 4-32

You can enter a carrier frequency in the range

250 kHz–2 GHz	3412
250 kHz–3 GHz	3413
250 kHz–4 GHz	3414

to a resolution of 1 Hz. Press the appropriate ENTER key to terminate.

The RF ON/OFF key

OUTP page 4-24

Switch the carrier *ON* or *OFF* at any time using RF ON/OFF.

This turns the RF output on and off, whilst retaining the 50 Ω output impedance.

The [△] key

Use this to vary any main function — carrier frequency, RF level, AM depth, FM/ΦM deviation or internal modulation source — from its keyed-in value. You can:

- Inspect the total shift from the last keyed-in value
- Change the step size when using the [x10 ⇩] and [÷10 ⇧] keys
- Transfer the current value as the keyed-in value
- Return the setting to the last keyed-in value.

This example uses carrier frequency, but it could equally well be any of the above functions.

1 Touch [Freq ...] to select carrier frequency as the current function.

2 Press [△] to display the screen (Fig. 3-18).

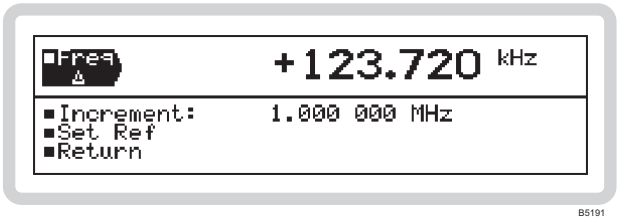


Fig. 3-18 Carrier shift and increment

■*Freq Δ*

1 The screen displays the difference between the current carrier frequency and the keyed-in (reference) value. Change this using the control knob or [x10 ⇩] and [÷10 ⇧] keys.

2 Make the current value the new reference by scrolling to ■*Set Ref* and pressing ENTER. This now becomes the reference value and the indicated shift value becomes zero.

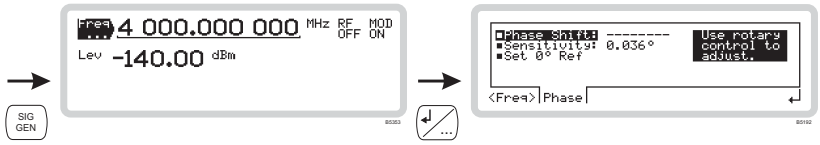
3 Cancel any changes by scrolling to ■*Return* and pressing ENTER. The carrier frequency is restored to the last keyed-in (reference) value and the indicated shift is set to zero.

■*Increment*

FREQ:STEP page 4-32

1 Scroll to *Increment* and use the numeric keyboard to set the size of step given by each press of the [x10 ⇩] and [÷10 ⇧] keys. Press ENTER. These keys now step the frequency up or down by the increment you have set.

2 Press [SIG GEN] to return to the main screen.



Carrier frequency menu — <Phase>

From this menu, you can:

- Adjust the phase offset of the carrier from the internal reference oscillator
- Set the rotary control sensitivity
- Set the carrier's phase as the reference.

From the carrier frequency menu of Fig. 3-17, touch <*Phase*> or press <TAB> to display the carrier phase screen (Fig. 3-19).

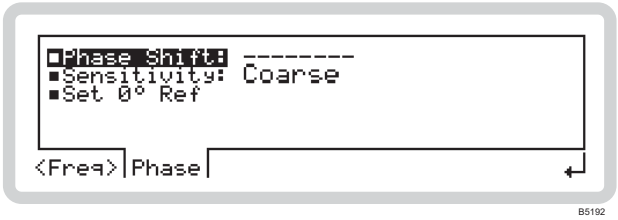


Fig. 3-19 Carrier phase

■*Phase Shift*

FREQ:PHAS page 4-33

Adjust the phase offset of the carrier, which is displayed on the screen, using the control knob.

***Tip**: If you subsequently change the carrier frequency, the established phase relationship is upset, and dashes appear on the display to indicate this.*

■*Sensitivity*

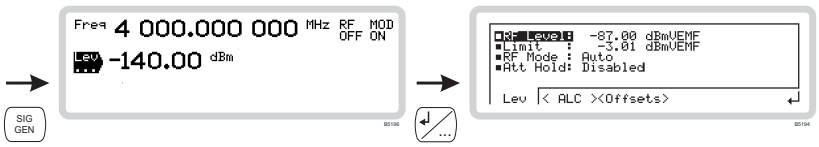
AM2:INT:PHAS:SENS page 4-50
FM2:INT:PHAS:SENS page 4-68
PM2:INT:PHAS:SENS page 4-88

Use the numeric keypad to set the sensitivity (resolution) of the rotary control: select from fine (0.036°), medium (0.360°) or coarse (1.440°).

■*Set 0°Ref*

FREQ:PHAS:REF page 4-34

Press ENTER to establish the current phase shift as the reference value. The indicated phase shift value is set to 0°.



RF level menu — <Lev>

From this menu, you can:

- Set the RF level of the carrier
- Set a limit on the level of RF output
- Set the instrument's noise mode.
- Set attenuator hold on or off.

1 Touch Lev to select the RF level menu on the main screen (Fig. 3-16).

2 Press ↵ to view the sub-menus. *RF Level* is highlighted (Fig. 3-20).

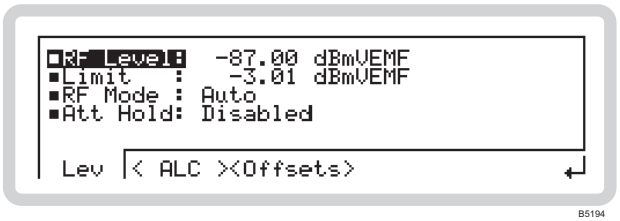


Fig. 3-20 RF level

■*RF Level*

POW page 4-93

Enter an RF level, terminating with the appropriate units key. You can change the units: see page 3-89.

■*Limit*

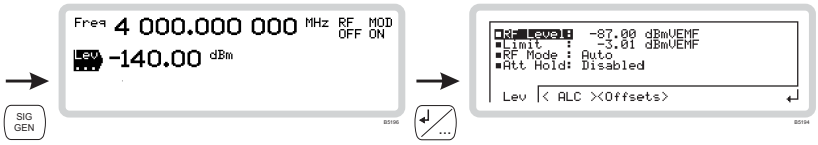
POW:LIM page 4-96

You can set your own maximum output power limit, which allows you to protect sensitive devices connected to the RF OUTPUT socket.

1 Set the level limit in the range –73 to +90 dBm. Terminate using the appropriate units key. You can change the units: see page 3-89.

The level limit you specify is for the device under test. The range allowed takes into account any offsets being applied (see page 3-30).

2 The setting is saved in non-volatile memory until changed again.



■*Noise mode*

POW:OPT page 4-97

A number of noise modes are available, with which you can optimize RF parameters such as maximum output power, noise floor and linearity of modulation.

Use the numeric keypad to specify the noise mode in order to optimize the carrier:

0	*Auto*	RF optimization mode is automatically selected on the basis of requested output power. This can be overridden, as shown below.
1	*Power*	Gives highest output power consistent with good noise floor figure and carrier harmonics. IQ/AM linearity is not specified.
2	*Noise*	Gives as good a noise floor figure as the *Power* mode, still with reasonable output power. AM with IQ modulation performance is specified but crest factor/linearity is compromised compared with *ACP* mode.
3	*ACP*	Gives optimal IQ linearity consistent with highest possible crest factor. Small compromise on noise floor/reduced output power.

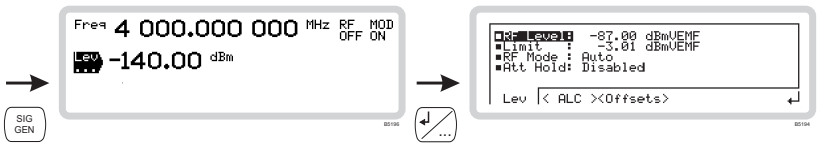
RF optimization — an illustration

Mode	Auto level (dBm)		Manual level (dBm		Floor noise @ >5 MHz offset (dBc/Hz)	Linearity	Maximum crest factor (dB)
	Max	Min	Max	Min*			
Power	+16	+10.01	+16	–128	<–142, typically –148	No requirement	3
Noise	+10	+0.01	+10	–134	<–142, typically –148	Meets AM spec.	9
ACP	0	–140	0	–144	<–142	Meets 3GPP and TETRA ACPR spec.	15**

(for carrier frequencies between 375 and 3000 MHz; principle applies throughout frequency range)

* Below these minimum levels the instrument shifts down to the next noise mode to give the requested output power.

** Higher crest factors (ratio of RMS to peak power) than 15 dB can be supported without clipping, provided that the external inputs are backed off appropriately from 0.5 V RMS.



■*Att Hold*

POW:ATT:AUTO page 4-93

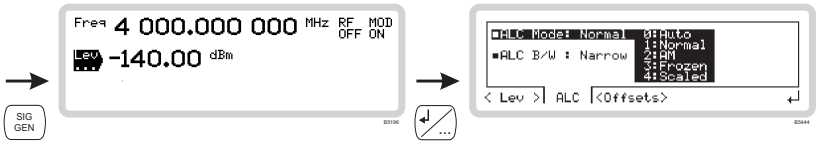
Use the numeric keys to choose *Disabled* or *Enabled*.

Enabled freezes the step attenuator at its current setting. You can then change the RF level over a range of 28 dB. Setting the instrument to *Low Noise* mode (page 3-26) gives the most symmetrical range. Note that the instrument will change mode if the entire 28 dB range is used.

With **attenuator hold enabled** and Lev ... as the current function, press any terminator key to set the RF level hardware for optimum level accuracy and spectral purity. If you subsequently change the attenuator setting, the instrument determines a new reference level and establishes a new 28 dB interrupt-free level-setting range.

With **attenuator hold disabled**, the RF level hardware is set for optimum level accuracy and spectral purity, and changes to the attenuator setting are possible.

Note that level accuracy and spectral purity cannot be guaranteed outside the normal level range.



RF level menu — <ALC>

- From this menu, you can specify how the RF output leveling is controlled

From the RF level menu of Fig. 3-20, touch <*ALC*> or press <TAB> to display the ALC screen (Fig. 3-21).

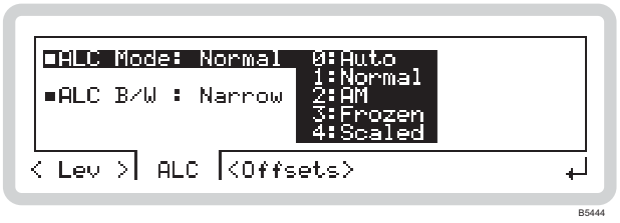


Fig. 3-21 ALC

■*ALC Mode*

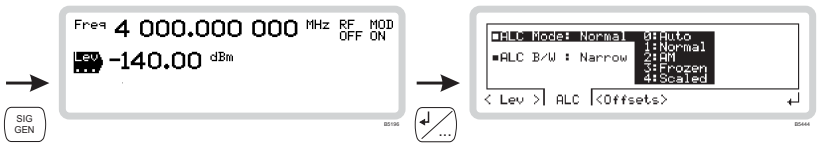
POW:ALC page 4-92

Use the numeric keypad to specify the automatic level control mode:

0	*Auto*	The leveling mode is selected automatically, depending on modulation type. The instrument selects *Normal* mode for CW, FM, PM and IQ, and *AM* mode when AM modulation is needed.
1	*Normal*	RF output power is controlled such that average power is leveled. IQ modulation can be applied as long as there is no slow variation of modulation with time (for example, QAM), where *Scaled* mode is the correct choice.
2	*AM*	Carrier power is leveled independently of the level of the modulation sidebands; leveling to average voltage.
3	*Frozen*	The leveling loop is frozen. When a frequency or level changes, the instrument performs a 'power search', during which the leveling system ensures that the output power is correct, and then freezes the leveling again. The output power is accurate, but varies with temperature or applied modulation level.* This mode is useful where burst profile information is included in the IQ baseband signals.
4	*Scaled*	Output power scales directly with IQ input power, but is leveled against temperature change. Useful where applied I and Q baseband signals contain slow time-varying information that must not be removed by the leveling loop (for example, QAM).

*This asssumes that the applied IQ modulation is 0.5 V RMS.

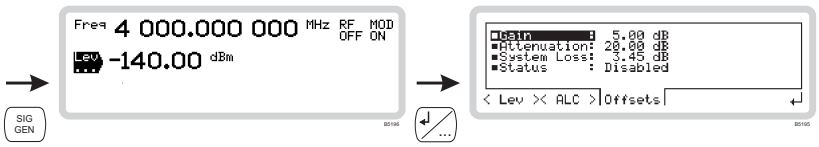
***Note**: For* Frozen *and* Scaled *modes, the external IQ inputs must be 0.5 V RMS to produce the nominal output power.*



■*ALC B/W*

Use the numeric keypad to specify the automatic level control bandwidth:

0	*Auto*	ALC bandwidth is set automatically depending on the modulation type, source and characteristics. For internal IQ modulation, the bandwidth is set to give the fastest settling time consistent with good signal quality (modulation accuracy and ACPR) as follows: *Narrow* set for AM and internal IQ where the symbol rate is < 100 kbit/s; *Broad* set for CW, FM, PM, external IQ and internal IQ where the symbol rate is > 100 kbit/s.
1	*Narrow*	Selects the slowest (largest) time constant. This is the default when IQ modulation is selected.
2	*Moderate*	Selects the intermediate time constant.
3	*Broad*	Selects the fastest (smallest) time constant.



RF level menu — <Offsets>

From this menu, you can offset the RF output to compensate for the loss or gain resulting from an external device or cabling connected between the instrument and the device under test (DUT) (Fig. 3-22).

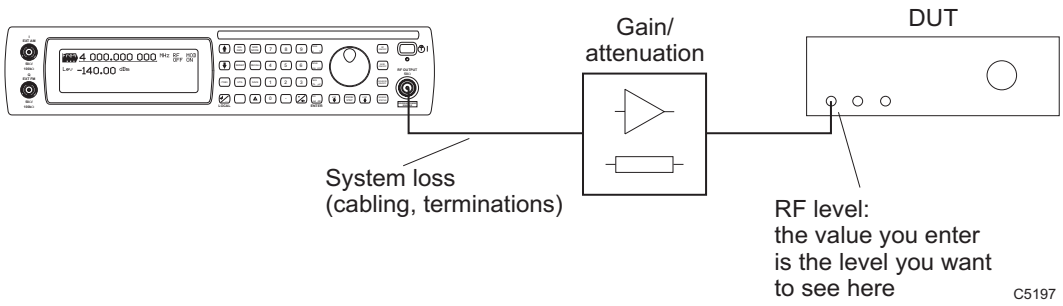


Fig. 3-22 RF level offsets

You set up the instrument so that:

- The RF level displayed is the level that you want at the DUT
- The gain or attenuation value is that of the external device and/or cabling.

The instrument automatically adjusts the signal level at its RF output to compensate for the external device and to ensure that the correct level is presented to the DUT.

RF level

Set the instrument's RF level (page 3-25) to the level that you require at the input of the DUT.

From the RF level menu of Fig. 3-20, touch <*Offsets*> or press <TAB> to display the RF offset screen (Fig. 3-23).

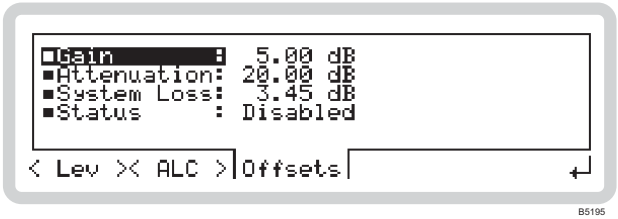
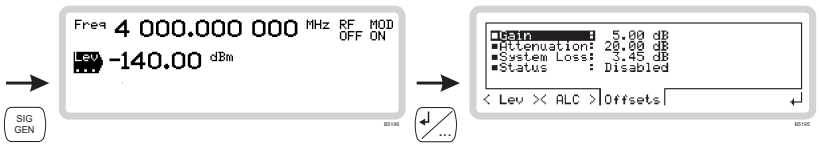


Fig. 3-23 RF level offset

■*Gain*

POW:OFFS page 4-94

Enter the gain of the external device (a positive value only, or 0), terminating with Hz rad dB.



■*Attenuation*

POW:OFFS:ATT page 4-94

Enter the attenuation of the external device (a positive value only, or 0), terminating with Hz rad dB.

■*System Loss*

POW:OFFS:LOSS page 4-95

Enter a figure for power loss through the cabling (a positive value only, or 0), terminating with Hz rad dB.

■*Status*

POW:OFFS:STAT page 4-95

Use the numeric keypad to choose whether the offsets are enabled or disabled.

Offsets example

You can calculate the power present at the instrument's output from the following equation:

Actual RF output power = displayed RF level – gain value + attenuation value + system loss value

So for example, if:

DUT requires –10 dBm at input,

Attenuation consists of a 5 dB pad,

Gain is 20 dB,

System loss is 3 dB:

Actual RF output power = –10 dBm – 20 dB +5 dB + 0 + 3 dB

= –22 dBm.

But note that you do not see this figure displayed! The instrument displays –10 dBm, the level required by the DUT.

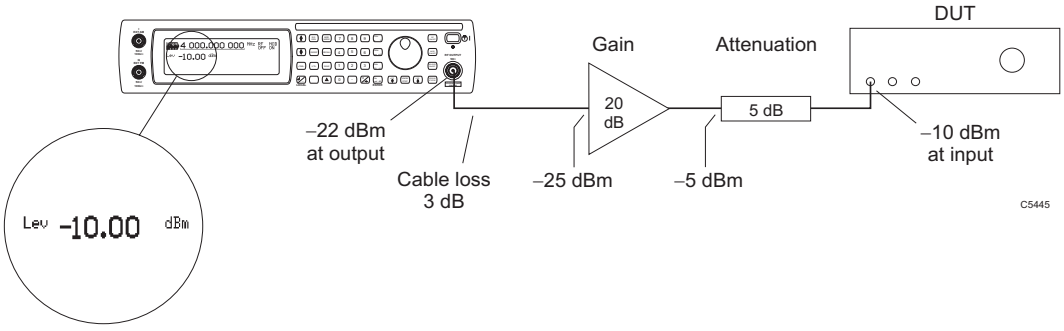


Fig. 3-24 Offsets example

Modulation summary

- You configure the instrument for IQ or analog modulation by pressing the IQ MOD or ANALOG MOD key to view the relevant modulation mode screen.
- You set up the type of modulation ('modulation mode') using the modulation mode screen. The main screen then displays function labels that reflect your choice of modulation.
- You set up the individual paths using the function labels.

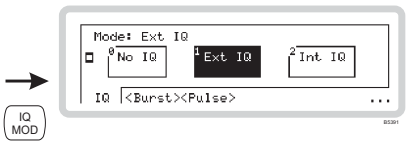
Possible combinations of modulation

Table 3-1 shows the possible combinations of modulation. The types of modulation available depend on the options fitted to your instrument, so some of these modulation types may not be available.

Table 3-1 Combinations of modulation

	Int AM1	Int (AM1+AM2)	Ext AM1	Int FM1	Int (FM1+FM2)	Ext FM1	Int PM1	Int (PM1+PM2)	Ext PM1	Internal IQ	External IQ	Pulse	Burst
Int AM1				✓	✓	✓	✓	✓	✓			✓	
Int (AM1+AM2)				✓		✓	✓		✓			✓	
Ext AM1				✓	✓	✓	✓	✓	✓			✓	
Int FM1	✓	✓	✓									✓	
Int (FM1+FM2)	✓		✓									✓	
Ext FM1	✓	✓	✓									✓	
Int PM1	✓	✓	✓									✓	
Int (PM1+PM2)	✓		✓									✓	
Ext PM1	✓	✓	✓									✓	
Internal IQ												✓	✓
External IQ												✓	✓
Pulse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Burst										✓	✓		

✓ Allowed combination



IQ modulation

Press IQ MOD to see the IQ modulation mode screen (Fig. 3-25). Use this to choose the type of IQ modulation to apply to the RF carrier. This screen may differ slightly, depending on the options fitted to your instrument.

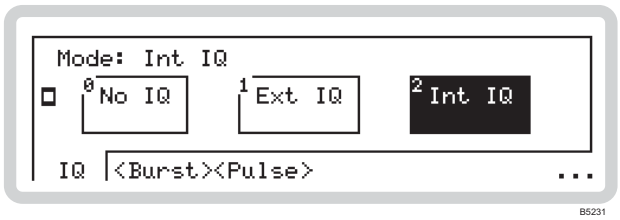


Fig. 3-25 Digital modulation mode

1 The screen shows the available configurations for the type of modulation selected on the soft tab at the bottom of the screen. The current modulation configuration is highlighted.

2 Touch any soft tab or scroll along the soft tabs using <TAB> to see the configurations of the various forms of modulation — IQ, Burst, Pulse and (if the real-time baseband option is fitted) External IQ.

3 Touch the appropriate soft box (for example, 2 Int IQ) to choose the modulation required
or
switch modulation off by touching the appropriate soft box (for example, 0 No IQ).

For example, in Fig. 3-25 the current selection is for internal IQ.

4 The three dots in the right-hand bottom corner of the screen show that you can press ↵ to see a relevant sub-menu that allows you to set up basic modulation parameters directly. This is explained on pages 3-36 to 3-39.

5 Press ↵ again to view the modulation mode screen.

6 Press SIG GEN to view the main screen, showing the current modulation mode.

Note that Internal IQ (ARB) operation is available only if Option 005 is fitted.

External IQ set-up

You can configure external IQ modulation directly from the *IQ* sub-menus on the main screen.

1 Configure the modulation mode for external IQ modulation (page 3-35).

2 Press SIG GEN to show the main screen, and touch the IQ soft box to select the function. Touch IQ ... and press ↵/... to view the external IQ modulation menu (Fig. 3-26).

Fig. 3-26 External IQ

From this screen you can:

- Turn external IQ modulation on or off
- Choose the input impedance at the external I and Q inputs
- Set up and perform self-calibration of the I and Q circuits.

External IQ menu — <IQ>

■*IQ State*

`IQ:STAT` page 4-76

Use the numeric keypad to turn the external IQ modulation on or off:

0 *Off*

1 *On*

■*Impedance*

`IQ:EXT:IMP` page 4-75

Use the numeric keypad to specify the impedance of the external IQ input:

0 *100 kΩ*

1 *50 Ω* Use 50 Ω for maximum bandwidth.

■*Self-Cal*

Run a self-calibration to make sure that the instrument meets the requirement specification. Touch the 0 Start Cal soft box, and the instrument performs the IQ self-calibration operation chosen from the *Config Cal* menu. An *Abort Cal* soft box appears, allowing you to stop the self-calibration if you wish.

External IQ menu — <Config Cal>

■*Mode*

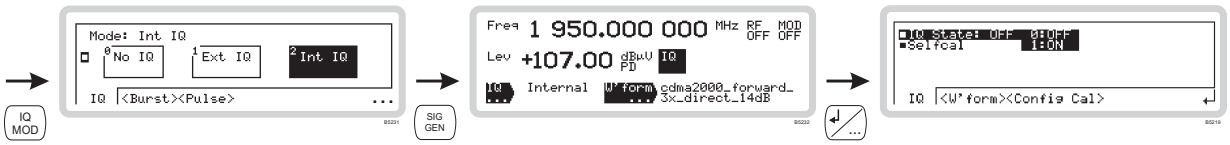
Use the numeric keypad to specify the external IQ self-calibration mode:

0	*Spot Freq*	Performs an IQ self-calibration at the current frequency.
1	*Freq Band*	A pop-up menu — ■*Freq Span* — appears. Use the numeric keypad to define the frequency span (with respect to the current carrier frequency) over which the IQ self-calibration is performed.

■*Operation*

Use the numeric keypad to specify how external IQ self-calibration starts when *Spot Freq* mode is selected:

0	*Manual*	Spot frequency IQ self-calibration starts when the 0 Start Cal soft box is pressed.
1	*Auto*	IQ self-calibration starts automatically whenever the carrier frequency or RF level changes.



Internal IQ set-up (ARB operation)

You can configure internal IQ modulation directly from the *IQ* sub-menus on the main screen.

1 Configure the modulation mode for internal IQ modulation (page 3-35).

2 Press SIG GEN to show the main screen, and touch the IQ soft box to select the function. Touch IQ ... and press ↵ ... to view the internal IQ modulation menu (Fig. 3-27).

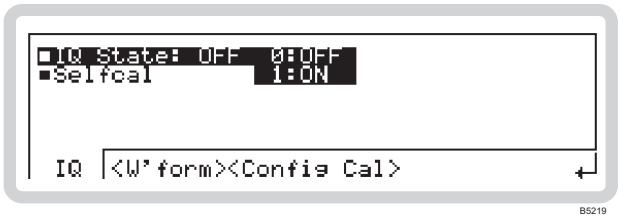


Fig. 3-27 Internal IQ

From this screen you can:

- Turn internal IQ modulation on or off
- Configure and perform a self-calibration on the I and Q signals
- Display (but not alter) the ARB settings.

Internal IQ menu — <IQ>

■*IQ State*

`OUT:MOD:IQ` page 4-21

Use the numeric keypad to turn internal IQ modulation on or off:

0 *Off*

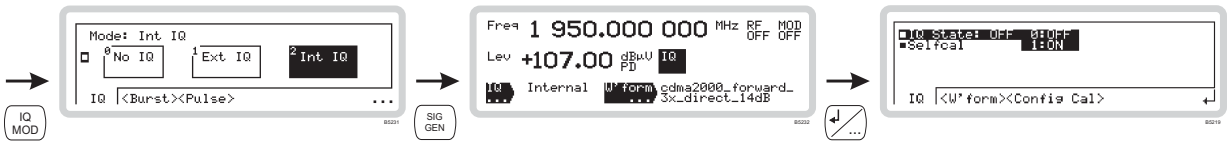
1 *On*

■*Self-Cal*

Touch the 0 Start Cal soft box, and the instrument performs the IQ self-calibration operation chosen from the *Config Cal* menu in order to re-align the IQ modulator. An *Abort Cal* soft box appears, allowing you to stop the self-calibration if you wish.

Internal IQ menu — <W'Form>

Details of the currently selected ARB waveform are displayed. Set the waveform up as shown on pages 3-40 onwards.



Internal IQ menu — <Config Cal>

■*Mode*

Use the numeric keypad to specify the internal IQ self-calibration mode:

0 *Spot Freq* Performs an IQ self-calibration at the current frequency.

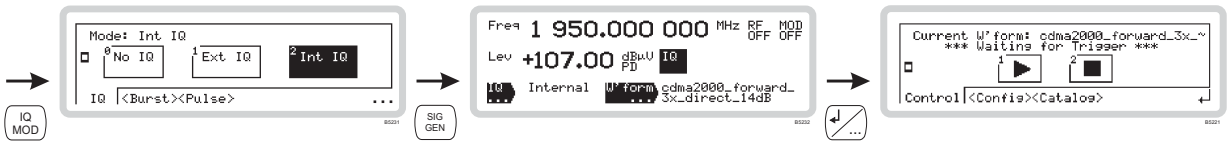
1 *Freq Band* A pop-up menu appears — ■*Freq Span*: use the numeric keypad to define the frequency span (with respect to the current carrier frequency) over which the IQ self-calibration is performed.

■*Operation*

Use the numeric keypad to specify how internal IQ self-calibration starts:

0 *Manual* Spot frequency IQ self-calibration starts when the 0 Start Cal soft box is pressed.

1 *Auto* IQ self-calibration starts automatically whenever the carrier frequency or RF level changes.



ARB waveform set-up

From this screen you can set up all aspects of the instrument's arbitrary waveform (ARB) generation.

1 Configure the modulation mode for internal IQ modulation (page 3-35).

2 Press SIG GEN to show the main screen, and touch the IQ soft box to select the function. Touch W'form and press ↵ to view the ARB waveform menu (Fig. 3-28).

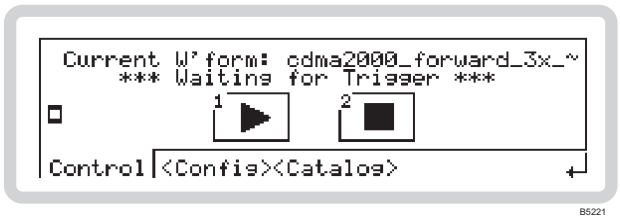


Fig. 3-28 ARB waveform

ARB menu — <Control>

From this menu, you can start and stop the output of the ARB generator by touching 'soft boxes' on the screen.

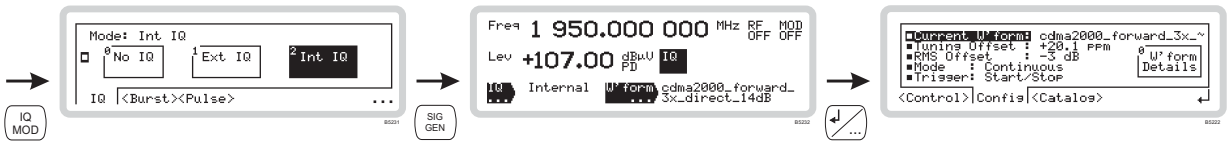
Messages on the screen shown the current status of the output: for example, *Waiting for Trigger*, *Generating Waveform*.

`IQ:ARB:INIT` page 4-70

Touch the *Play* soft box to start generation of a waveform. If generation is set to *Continuous* (*Mode*, page 3-42) the waveform plays indefinitely.

`IQ:ARB:ABOR` page 4-70

Stop the output at any time by touching this soft box. The ARB generator halts immediately.



ARB menu — <Config>

From this menu, you can:

- View details of the currently selected waveform
- Define the tuning offset
- Define the RMS offset
- Define whether the output is to be continuous or single-shot
- Define how the trigger controls the output.

From the ARB control menu of Fig. 3-28, touch <*Config*> or press <TAB> to display the ARB configuration screen (Fig. 3-29).

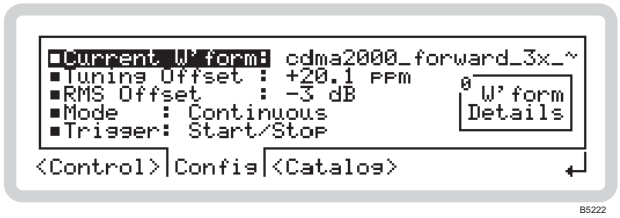


Fig. 3-29 ARB configuration

■*Current W'form*

IQ:ARB:WAV:CAT page 4-74

1 The currently selected waveform is displayed.

2 Touch the [W'form Details] soft box to show details of the current waveform. Because it is a stored sample, you cannot change its parameters here.

3 Touch the [Config] soft box to take you back to the ARB configuration screen.

■*Tuning Offset*

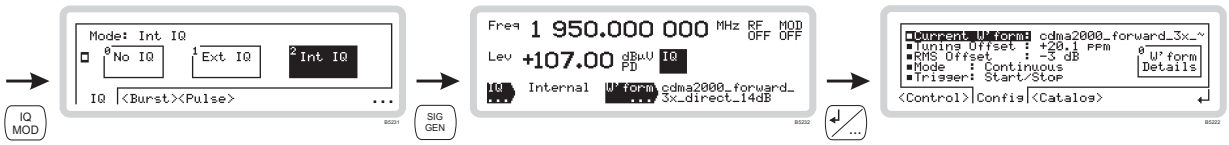
IQ:ARB:TOFF page 4-71

Use the numeric keypad (terminate with any ENTER key) to specify a small change to the stored sample rate.

■*RMS Offset*

IQ:ARB:ROFF page 4-71

Use the numeric keypad (terminate with any ENTER key) to vary the RMS level of the signal from the ARB into the IQ modulator.



■*Mode*

IQ:ARB:MODE page 4-70

Use the numeric keypad to specify the waveform play mode:

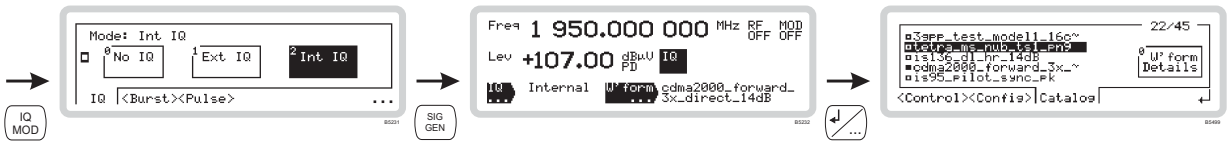
0	*Single*	Single play. The waveform outputs once and stops, ready to play again.
1	*Continuous*	Continuous play. The waveform outputs from the beginning and then starts again when the end of the file is reached.

■*Trigger*

IQ:TRIG page 4-72

Use the numeric keypad to specify the external trigger mode:

		Single mode	Continuous mode
0	*Immediate*	When you select it, the waveform plays once. Stop and start it using the ARB controls (page 3-40).	When you select it, the waveform plays continuously. Stop and start it using the ARB controls (page 3-40).
1	*Start*	The first trigger starts the waveform. At the end of the waveform the trigger latch resets, ready for the next input. During the output, trigger inputs are ignored. The trigger can either be manual (1 ▶) or from the external trigger input.	The first trigger starts the waveform running continuously. The instrument ignores any further trigger inputs. Stop generation of the waveform at any time by touching 2 ■ ; the trigger latch resets, ready for the next input. The trigger can either be manual (1 ▶) or from the external trigger input.
2	*Start/Stop*	The first trigger starts the waveform, the next trigger stops it. The trigger latch resets after each start/stop. The trigger can either be manual (1 ▶) or from the external trigger input.	The first trigger starts the waveform, the next trigger stops it. The trigger latch resets after each start/stop. The trigger can either be manual (1 ▶) or from the external trigger input.



ARB menu — <Catalog>

IQ:ARB:WAV:CAT page 4-72

From this menu, you can:

- View a list of the stored waveforms
- Inspect the details of each waveform.
- Erase selected waveforms

From the ARB control menu of Fig. 3-28, touch <*Catalog*> or press <TAB> to display the catalog screen (Fig. 3-30).

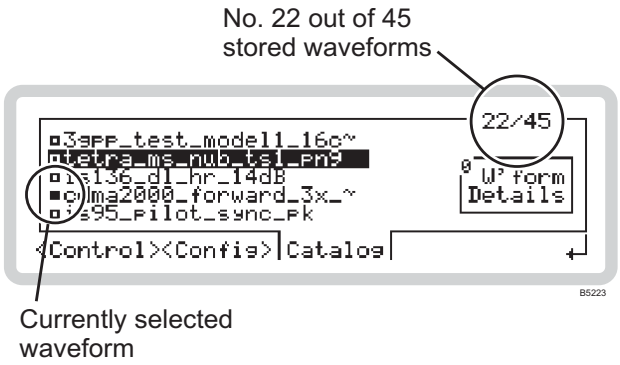


Fig. 3-30 ARB catalog

1 The currently selected waveform is shown by a solid box (■), others waveforms by a hollow box.

2 Numbers at the top right of the screen show the current position in the list, and the total number of waveforms stored.

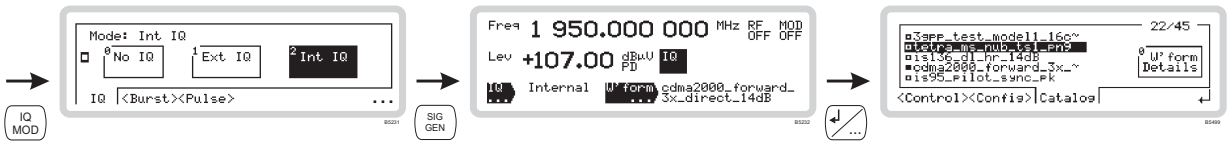
3 Move up and down the list using the ↓ and ↑ navigation keys. If the name is too long to fit on this screen, it is shown by a final dash –. Press ENTER to select the highlighted waveform.

4 Touch the 0 W'form Details soft box to show details and the full name of the current waveform. Because it is a stored sample, you cannot change its parameters here.

5 Touch the 0 Catalog soft box to take you back to the ARB catalog screen.

Erasing a waveform file

- Select the waveform file that you want to erase.
- Press ↵….
- If you want to cancel the request, press ←; otherwise:
- Confirm by pressing ENTER — the file is erased, and an updated catalog screen displayed.



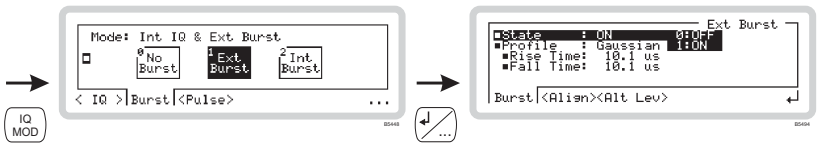
ARB waveform format

Information on the format of an ARB waveform, its header structure and marker bits, appears on page 3-121.

IQCreator™

IQCreator ™ is a software package that allows you to create and package an arbitrary waveform file that can be loaded onto a 3410 Series signal generator. It is also possible to package and download files that have been created using other tools. Arbitrary waveforms that can be created by ***IQCreator*** ™ cover a wide range of digital modulation schemes.

IQCreator ™ is supplied on the CD-ROM that accompanies your instrument, together with a user manual (part number 46882/599) that gives details of how to create, download and package waveforms to run on the ARB.



Burst modulation set-up

Introduction to burst modulation

From these menus, you can define the shape of a burst waveform (profile, rise and fall times) and its alignment (trigger interval, burst offset, change in duration). You can specify a reduced output level for a particular burst — the alternative level — if an electronic attenuator (option 003) is fitted.

In Fig. 3-31, marker 1 or an external trigger gates the RF signal on and off. Marker 2 or burst attenuation control, when applied to a particular burst, causes its level to be reduced by the amount specified in the *Burst Atten* field.

The auxiliary port connector (chapter 2) outputs marker bits and accepts external burst controls.

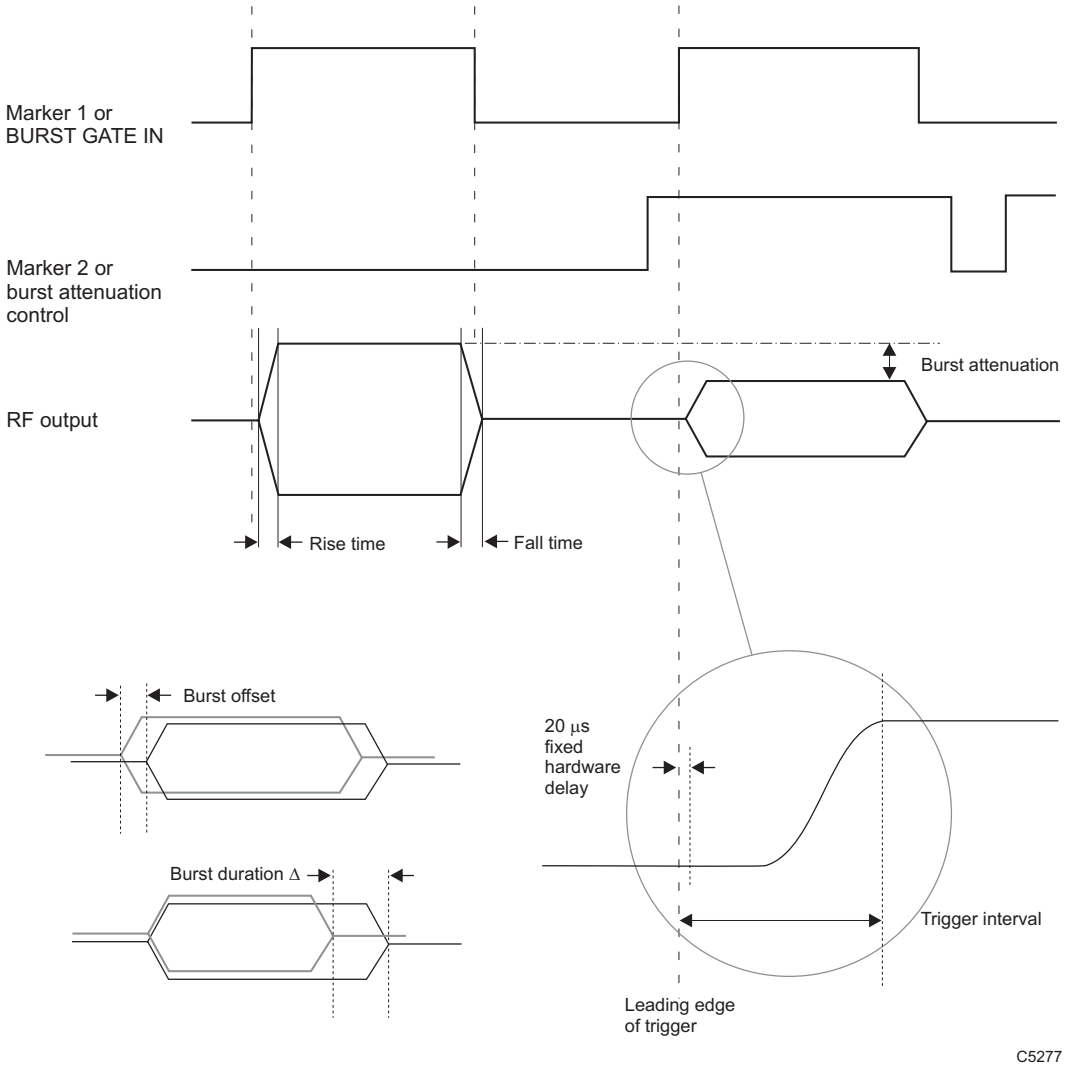
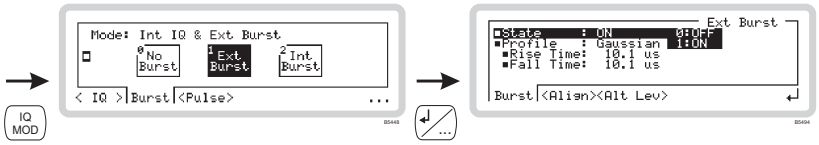


Fig. 3-31 Burst trigger timing



Burst set-up

1 Press IQ MOD to see the IQ modulation mode screen.

2 Touch <*Burst*>, and then the appropriate soft box to choose internal or external burst.

3 Press ↵ to view the burst profile screen (Fig. 3-32).

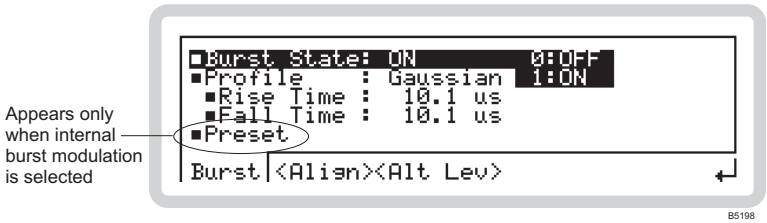


Fig. 3-32 Burst modulation

Burst waveform — <Burst>

■*Burst State*

BURS:SOUR page 4-54

Use the numeric keypad to turn burst modulation on or off.

■*Profile*

Use the numeric keypad to specify the profile of the burst waveform:

0	*None*	Unshaped waveform with very fast rise and fall times.
1	*Cosine*	Waveform with a slower response, giving few sidebands for best ACP.
2	*Gaussian*	Waveform with steeper rise and fall times, suitable for GSM testing.

■*Rise Time*

BURS:RTIM page 4-53

Use the numeric keypad to specify the rise time for the cosine or gaussian burst profile. Rise time is limited by the trigger interval.

■*Fall Time*

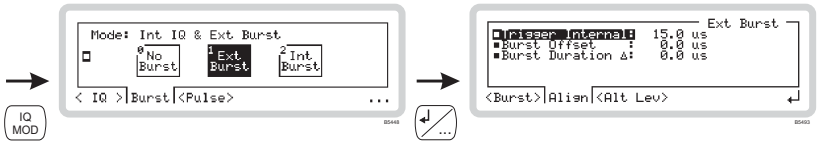
BURS:FTIM page 4-53

Use the numeric keypad to specify the fall time for the cosine or gaussian burst profile.

■*Preset* (internal burst modulation only)

IQ:ARB:WAV:BURS:PRES page 4-72

Press ENTER to restore burst settings to the default values stored in the current waveform header.



Burst waveform — <Align>

From this menu, you can vary the alignment of the burst with respect to the marker 1 bit or external trigger input.

■*Trigger Interval*

BURS:TINT page 4-54

Use the numeric keypad to specify the trigger interval for the burst. The trigger interval (see Fig. 3-31) can be used to make small adjustments to the timing of the start of the burst with respect to the marker 1 or external trigger input.

The trigger interval includes a fixed 20 µs delay that represents the combination of different delays within the instrument's hardware.

The trigger interval will vary as the burst offset (below) is changed. It is also affected by the waveform's rise time.

***Note**: for internal burst modulation, the trigger interval cannot be adjusted from the front panel.*

■*Burst Offset*

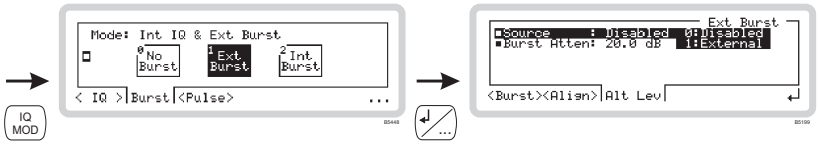
BURS:OFFS page 4-53

Use the numeric keypad to specify the offset for the burst. Burst offset (see Fig. 3-31) varies the position of the complete burst with respect to the marker 1 or external trigger input.

■*Burst Duration Δ*

BURS:DDEL page 4-52

Use the numeric keypad to specify the duration Δ for the burst. Burst duration Δ (see Fig. 3-31) varies the length of the burst.



Burst waveform — <Alt Lev>

From this menu, you can define the trigger source for burst attenuation and its level.

■*Source*

BURS:ALT:SOUR page 4-52

Use the numeric keypad to specify the trigger source for the burst.

Internal is available only when the ARB option is fitted.

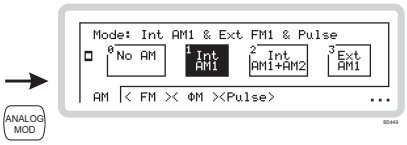
■***Burst Atten*** (electronic attenuator only)

BURS:ALT:ATT page 4-52

Use the numeric keypad to specify the burst attenuation.

The value you enter represents the difference in level between the burst waveform and the nominal output.

Tip: *You can also access the Burst and Alternative Level menus from the main screen. First, set the burst type on the IQ modulation screen. Press* SIG GEN *to show the main screen, touch the* Burst *soft box, then press* ↵/... .



Analog modulation

Press ANALOG MOD to see the analog modulation mode screen (Fig. 3-33). Use this to choose the type of analog modulation to apply to the RF carrier. This screen may differ slightly, depending on the options fitted to your instrument.

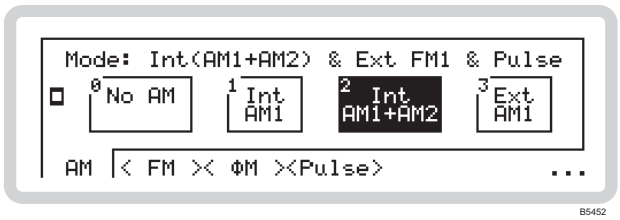


Fig. 3-33 Analog modulation mode

1 The screen shows the available configurations for the type of modulation selected on the soft tab at the bottom of the screen. The current modulation configuration is highlighted.

2 Touch any soft tab or scroll along the soft tabs using <TAB> to see the configurations of the various forms of modulation — AM, FM, Phase and Pulse.

3 Touch the appropriate soft box (for example, 1 Int AM1) to choose the modulation required
or
switch modulation off by touching the appropriate soft box (for example, 0 No AM).

For example, in Fig. 3-33 the current selection is for two internal AM signals together with an external FM signal and pulse.

4 The three dots in the right-hand bottom corner of the screen show that you can press ↵/... to see a relevant sub-menu that allows you to set up basic modulation parameters (for example, AM depth) directly. This is explained on pages 3-51 to 3-60.

5 Press ↵/... again to view the modulation mode screen.

6 Press SIG GEN to view the main screen, showing the current modulation mode.

Path set-up

Before setting up the analog internal/external sources and modulation paths, you may find it helpful to look at Fig. 3-34.

It shows the various parameters that may be set up, and the menus in which you can find them, for amplitude modulation. The FM and ΦM modulation diagrams would be very similar, and so are not repeated.

While this diagram does not set out to portray accurately the instrument's hardware, it does represent the effect of the menus on the instrument's operation.

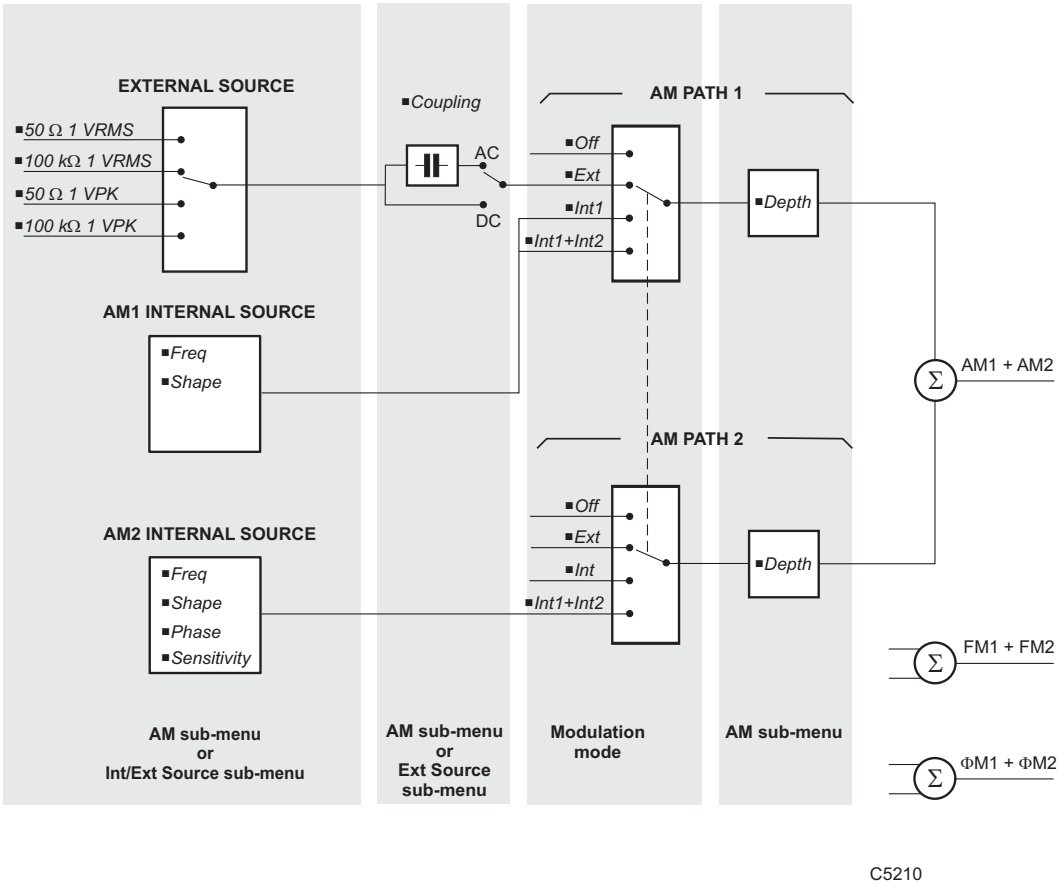
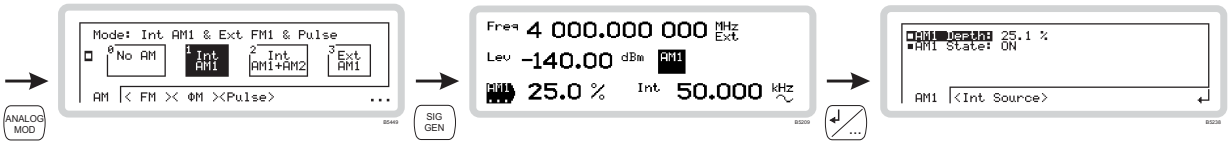


Fig. 3-34 Path set-up

Parameters that can be adjusted are shown as (for example) ■*Freq*.

Apart from selecting the signal path(s), all parameters can be adjusted from the AM, FM and ΦM sub-menus on pages 3-51 to 3-57. They can also be adjusted from the internal source sub-menus on pages 3-61 to 3-64.



AM1 set-up

Use this menu to apply amplitude modulation (on path 1) to the internal source, or to configure the input of the external source.

1 Configure the modulation mode for internal or external modulation (page 3-49).

2 Press [SIG GEN] to show the main screen, and touch the [AM1] soft box to select the function (Fig. 3-35).

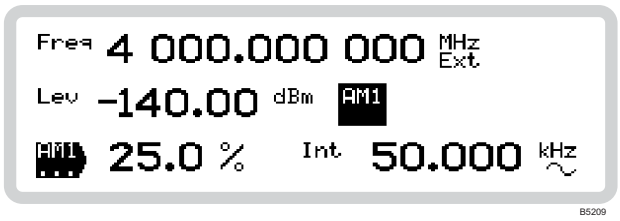


Fig. 3-35 AM1 main screen

Set **AM depth** or **internal modulation frequency** directly:

1 Touch the relevant function label on the screen ([AM1 ...] or [Int ...]).

2 Enter the value using the numeric keypad. Terminate using the appropriate units key.

AM1 sub-menu — <AM1>

Touch the [AM1] soft box to select the function. Touch [AM1 ...] and press [↵ ...] to view the AM1 sub-menu (Fig. 3-36).

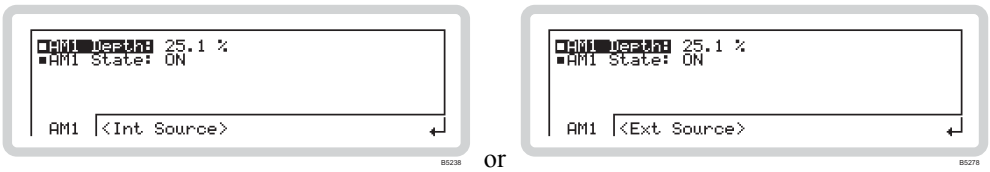


Fig. 3-36 AM1sub-menu

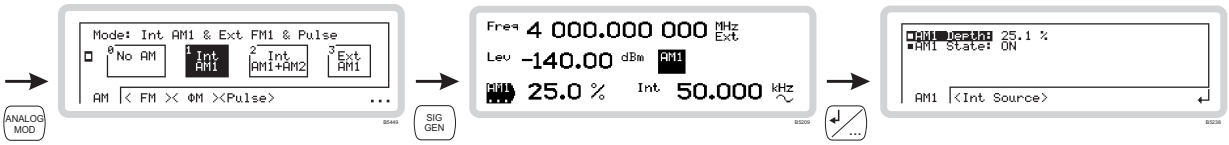
From this menu you can:

- Specify the modulation depth
- Turn AM1 modulation source on and off.

■*AM1 Depth*

AM page 4-41

Use the numeric keypad or the [↓] and [↑] keys to specify the AM1 modulation depth (%).



■*AM1 State*

OUTP:MOD:AM page 4-20

Use the numeric keypad to turn AM1 modulation source on or off:

0 *Off*

1 *On*

AM1 sub-menu — <Int Source> or <Ext Source>

Either of these soft tabs may appear, depending on whether you have defined the source for AM1 as internal or external on the modulation mode menu (page 3-49).

<Int Source>

From this menu you can:

- Specify the source's frequency and waveshape.

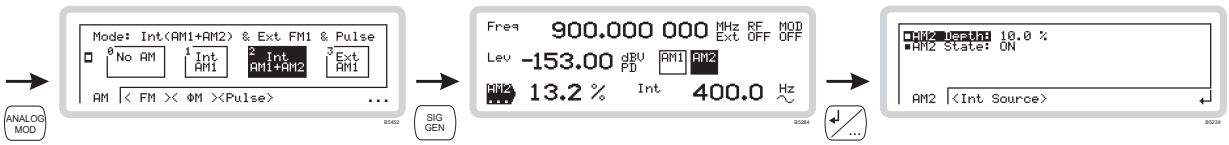
Follow the instructions for ■*Int Freq* and ■*Int Shape* on page 3-61.

<Ext Source>

From this menu you can:

- Specify the coupling of the external source (DC or AC)
- Define the input impedance and sensitivity of the inputs.

Follow the instructions for ■*Coupling*, ■*Impedance* and ■*Sensitivity* on page 3-64.



AM2 set-up

Use this menu to apply amplitude modulation (on path 2) to the internal source.

The AM2 path only becomes available when you select composite modulation (AM1 + AM2).

Set up the AM2 path exactly as the AM1 path, but using the AM2 function label.

AM2 sub-menu — <AM2>

From this menu you can:

- Specify the modulation depth
- Turn AM2 modulation source on and off.

■*AM2 Depth*

AM page 4-41

Use the numeric keypad or the ↓ and ↑ keys to specify the AM2 modulation depth (%).

■*AM2 State*

OUTP:MOD:AM page 4-20

Use the numeric keypad to turn AM2 modulation source on or off:

0 *Off*

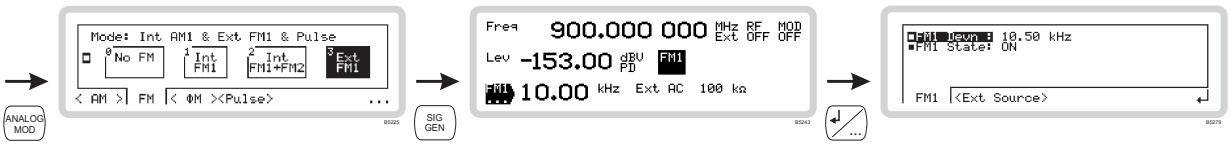
1 *On*

AM2 sub-menu — <Int Source>

From this menu you can:

- Specify the source's frequency and waveshape
- Define the phase relationship of one path to another
- Set the resolution of the rotary control when defining the phase relationship.

Follow the instructions for ■*Int Freq*, ■*Int Shape,* ■*Phase Diff* and ■*Sensitivity* on page 3-61.



FM1 set-up

Use this menu to apply frequency modulation (on path 1) to the internal source, or to configure the input of the external source.

1 Configure the modulation mode for internal or external modulation (page 3-49).

2 Press [SIG GEN] to show the main screen, and touch the [FM1] soft box to select the function (Fig. 3-37).

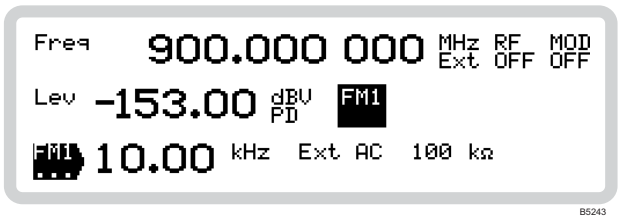


Fig. 3-37 FM1 main screen

Set **FM deviation** or **internal modulation frequency** directly:

1 Touch the relevant function label on the screen ([FM1 . . .] or [Int . . .]).

2 Enter the value using the numeric keypad. Terminate using the appropriate units key.

FM1 sub-menu — <FM1>

Touch the [FM1] soft box to select the function. Touch [FM1 . . .] and press [↵ . . .] to view the FM1 sub-menu (Fig. 3-38).

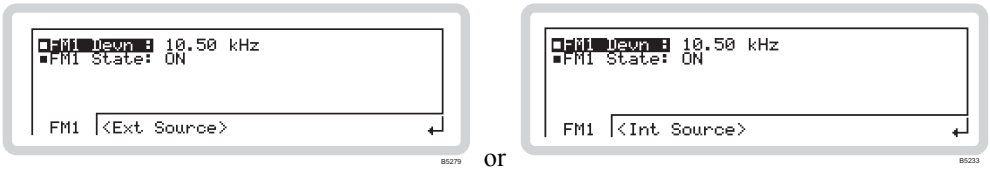


Fig. 3-38 FM1sub-menu

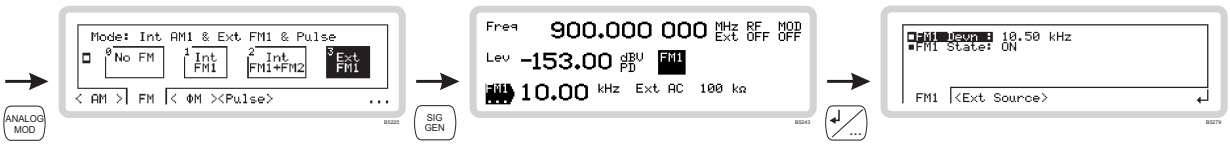
From this menu you can:

- Specify the deviation of the modulating frequency
- Turn FM1 modulation source on and off.

■*FM1 Devn*

FM page 4-59

Use the numeric keypad or the [↓] and [↑] keys to specify the FM1 deviation.



■*FM1 State*

OUTP:MOD:FM page 4-21

Use the numeric keypad to turn FM1 modulation source on or off:

0 *Off*

1 *On*

FM1 sub-menu — <Int Source> or <Ext Source>

Either of these soft tabs may appear, depending on whether you have defined the source for FM1 as internal or external on the modulation mode menu (page 3-49).

<Int Source>

From this menu you can:

- Specify the source's frequency and waveshape.

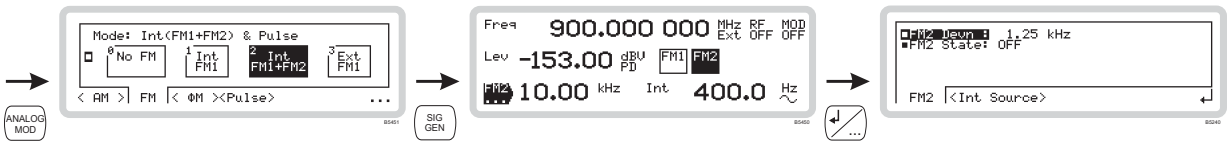
Follow the instructions for ■*Int Freq* and ■*Int Shape* on page 3-61.

<Ext Source>

From this menu you can:

- Specify the coupling of the external source (DC or AC)
- Perform a DC null on the input signal
- Define the input impedance and sensitivity of the inputs.

Follow the instructions for ■*Coupling*, ■*DCFM Null*, ■*Impedance* and ■*Sensitivity* on page 3-64.



FM2 set-up

Use this menu to apply frequency modulation (on path 2) to the internal source.

The FM2 path only becomes available when you select composite modulation (FM1 + FM2).

Set up the FM2 path exactly as the FM1 path, but using the FM2 function label.

FM2 sub-menu — <FM2>

From this menu you can:

- Specify the deviation of the modulating frequency
- Turn FM2 modulation source on and off.

■*FM2 Devn*

FM page 4-59

Use the numeric keypad or the ↓ and ↑ keys to specify the FM2 deviation.

■*FM2 State*

OUTP:MOD:FM page 4-21

Use the numeric keypad to turn FM2 modulation source on or off:

0 *Off*

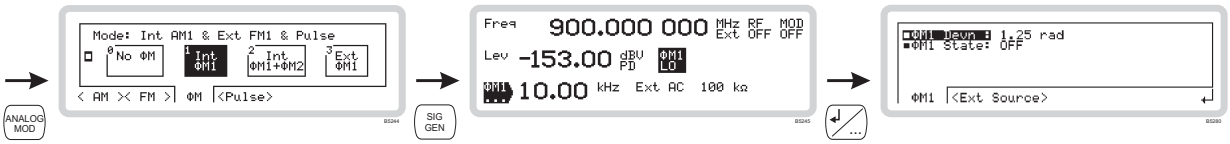
1 *On*

FM2 sub-menu — <Int Source>

From this menu you can:

- Specify the source's frequency and waveshape
- Define the phase relationship of one path to another
- Set the resolution of the rotary control when defining the phase relationship.

Follow the instructions for ■*Int Freq*, ■*Int Shape,* ■*Phase Diff* and ■*Sensitivity* on page 3-61.



ΦM1 set-up

Use this menu to apply phase modulation (on path 1) to the internal source, or to configure the input of the external source.

1 Configure the modulation mode for internal or external modulation (page 3-49).

2 Press [SIG GEN] to show the main screen, and touch the [ΦM1] soft box to select the function (Fig. 3-39).

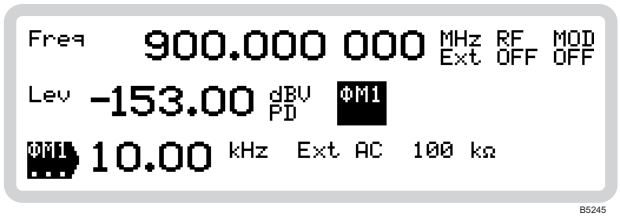


Fig. 3-39 ΦM1 main screen

Set **ΦM deviation** or **internal modulation frequency** directly:

1 Touch the relevant function label on the screen ([ΦM1 ...] or [Int ...]).

2 Enter the value using the numeric keypad. Terminate using the appropriate units key.

ΦM1 sub-menu — <ΦM1>

Touch the [ΦM1] soft box to select the function. Touch [ΦM1 ...] and press [↵/...] to view the ΦM1 sub-menu (Fig. 3-40).

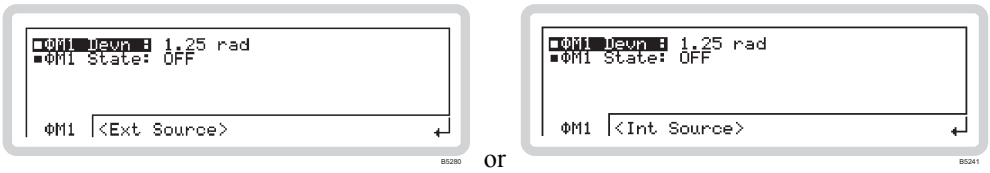


Fig. 3-40 ΦM1 sub-menu

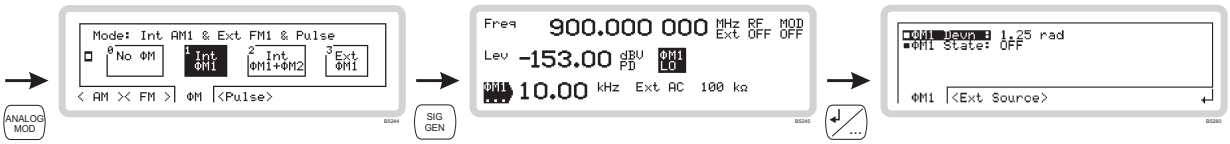
From this menu you can:

- Specify the deviation of the modulating frequency
- Turn ΦM1 modulation source on and off.

■ *ΦM1 Devn*

ΦM page 4-79

Use the numeric keypad or the [↓] and [↑] keys to specify the ΦM1 deviation.



■*ΦM1 State*

OUTP:MOD:PM page 4-22

Use the numeric keypad to turn ΦM1 modulation source on or off:

0 *Off*

1 *On*

ΦM1 sub-menu — <Int Source> or <Ext Source>

Either of these soft tabs may appear, depending on whether you have defined the source for ΦM1 as internal or external on the modulation mode menu (page 3-49).

<Int Source>

From this menu you can:

- Specify the source's frequency and waveshape.

Follow the instructions for ■*Int Freq* and ■*Int Shape* on page 3-61.

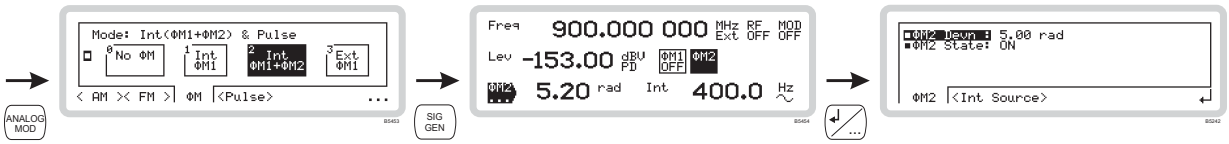
<Ext Source>

From this menu you can:

- Perform a DC null on the input signal
- Define the input impedance and sensitivity of the inputs

***Note**: ΦM coupling is always AC.*

Follow the instructions for ■*DCFM Null*, ■*Impedance* and ■*Sensitivity* on page 3-64.



ΦM2 set-up

Use this menu to apply phase modulation (on path 2) to the internal source.

The ΦM2 path only becomes available when you select composite modulation (ΦM1 + ΦM2).

Set up the ΦM2 path exactly as the ΦM1 path, but using the ΦM2 function label.

ΦM2 sub-menu — <ΦM2>

From this menu you can:

- Specify the deviation of the modulating frequency
- Turn ΦM2 modulation source on and off.

■*ΦM2 Devn*

PM page 4-79

Use the numeric keypad or the ↓ and ↑ keys to specify the ΦM2 deviation.

■*ΦM2 State*

OUTP:MOD:PM page 4-22

Use the numeric keypad to turn ΦM2 modulation source on or off:

0 *Off*

1 *On*

ΦM2 sub-menu — <Int Source>

From this menu you can:

- Specify the source's frequency and waveshape
- Define the phase relationship of one path to another
- Set the resolution of the rotary control when defining the phase relationship.

Follow the instructions for ■*Int Freq*, ■*Int Shape,* ■*Phase Diff* and ■*Sensitivity* on page 3-61.

Pulse modulation set-up

If the pulse option is fitted to your instrument, you can configure pulse modulation directly from the *Pulse* sub-menu on the main screen.

Pulse modulation

1 Configure the modulation mode for Pulse (page 3-49).

2 Press SIG GEN to show the main screen, and touch the Pulse soft box to select the function. Press ↵/... to view the pulse modulation menu (Fig. 3-41).

Fig. 3-41 Pulse modulation

■*Pulse State*

`OUTP:MOD:PULM` page 4-22

Use the numeric keypad to turn the pulse modulation source on or off:

0 *Off*

1 *On*

Internal source set-up

The internal source can modulate the carrier through up to three modulation paths (see Fig. 3-34). You can configure these either:

- via the *AM/FM/ΦM* sub-menus on the main screen, or
- directly from the *Int* sub-menu on the main screen.

In this section, we set up the internal source directly.

Modulation path 1

1 Configure the modulation mode to select a first modulation path (for example, AM1) (page 3-49).

2 Press SIG GEN to show the main screen and touch the Int function label to select the function. Press ↵ to view the internal source menu for path 1 (Fig. 3-42).

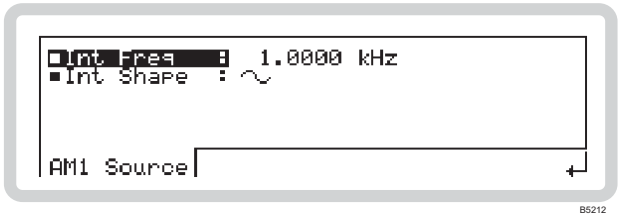


Fig. 3-42 Internal source, modulation path 1

The soft tab shows the modulation path that *Int* is associated with — in this example, *AM1*. It could also be *FM1* or *ΦM1*.

From this menu you can:

- Specify the source's frequency and waveshape

▪Int Freq

AM:INT:FREQ	page 4-43
FM:INT:FREQ	page 4-61
PM:INT:FREQ	page 4-81

Use the numeric keypad or the x10 and ÷10 keys to specify the frequency of the internal source.

■*Int Shape*

AM:INT:SHAP page 4-48
FM:INT:SHAP page 4-66
PM:INT:SHAP page 4-86

Use the numeric keypad to specify the waveshape of the internal source:

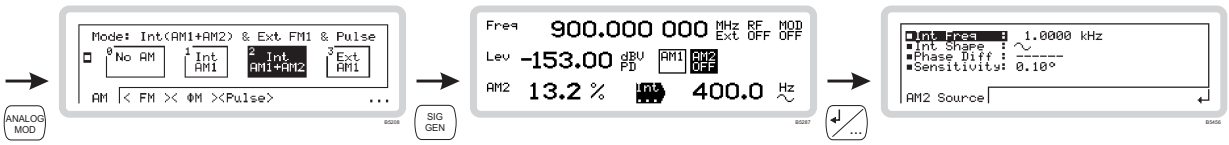
0 *Sine*

1 *Triangle*

2 *Square*

3 *Ramp*

Note: *Triangle, square and ramp waveforms are specified to lower maximum frequencies than the sine wave's 50 kHz. They can also be used at frequencies up to 50 kHz, but become progressively more distorted (due to filtering of harmonics) as the frequency limit is approached.*



Modulation path 2

Use this menu to set up the internal source for a second modulation path. Set it up the same way as for the first modulation path.

The soft tab shows the modulation path that Int is associated with — in this example, AM2. It could also be FM2 or ΦM2.

From this menu you can:

- Specify the source's frequency and waveshape
- Define the phase relationship of one path to another
- Set the resolution of the rotary control when defining the phase relationship.

■Int Freq

AM2:INT:FREQ page 4-43
FM2:INT:FREQ page 4-61
PM2:INT:FREQ page 4-81

Use the numeric keypad or the [x10] and [÷10] keys to specify the frequency of the internal source.

■Int Shape

AM2:INT:SHAP page 4-48
FM2:INT:SHAP page 4-66
PM2:INT:SHAP page 4-86

Use the numeric keypad to specify the waveshape of the internal source:

0 *Sine*

1 *Triangle*

2 *Square*

3 *Ramp*

■Phase Diff

AM2:INT:PHAS page 4-50
FM2:INT:PHAS page 4-68
PM2:INT:PHAS page 4-87

Use the numeric keypad or the control knob to set the phase of modulation path 2 relative to modulation path 1.

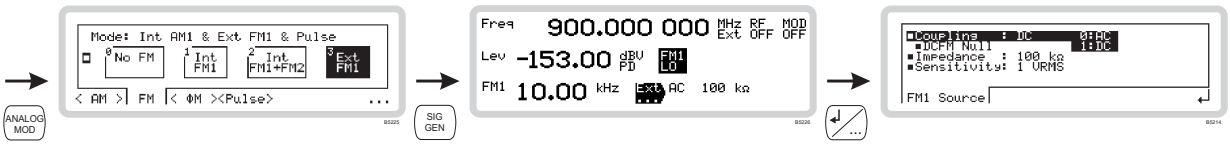
■Sensitivity

Use the numeric keypad to specify the sensitivity of the rotary control when setting up the *Phase Difference*:

0 *0.01° resolution (fine)*

1 *0.1° resolution (medium)*

2 *1.0° resolution (coarse)*



External source set-up

You can configure external sources either:

- via the *AM/FM/ΦM* sub-menus on the main screen, or
- directly from the *Ext* sub-menus on the main screen.

In this section, we set up an external source directly.

External source

1 Configure the modulation mode for external modulation (page 3-49).

2 Press SIG GEN to show the main screen and touch the Ext ... function label to select the function. Press ↵/... to view the external source menu (Fig. 3-43).

Fig. 3-43 External source

The soft tab shows the modulation path that *Ext* is associated with — in this example, *FM1*. It could also be *AM1* or *ΦM1*.

From this menu you can:

- Define the coupling of the external source (DC or AC)
- Perform a DC null on the input signal
- Define the input impedance and sensitivity of the inputs.

■*Coupling*

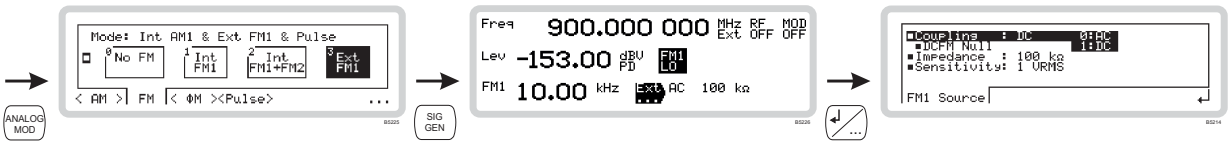
AM:EXT:COUP	page 4-42
FM:EXT:COUP	page 4-60

Use the numeric keypad to specify the coupling of the external source (not PM):

0 *AC*

1 *DC*

In most cases, the instrument achieves the effect of AC coupling by removing any DC offset on which the signal is superimposed.



■*DCFM Null*

This menu entry only appears on the screen when DC coupling is selected.

The instrument prompts you to apply a ground reference to the external modulation input. Press ENTER to perform a DC nulling operation to reduce any small frequency offsets due to the DC coupling.

■*Impedance*

AM:EXT:IMP page 4-42
FM:EXT:IMP page 4-60
PM:EXT:IMP page 4-80

Use the numeric keypad to specify the impedance of the external source input:

0 *100 kΩ*

1 *50 Ω*

■*Sensitivity*

AM:EXT:SENS page 4-43
FM:EXT:SENS page 4-61
PM:EXT:SENS page 4-80

Use the numeric keypad to specify the sensitivity of the external source input:

0 *1 VRMS* 1 V RMS at the input gives the chosen AM depth/FM deviation.

1 *1 VPK* 1 V peak at the input gives the chosen AM depth/FM deviation.

Sweep

Press SWEEP to see the main sweep screen (Fig. 3-44), from which you can set up all aspects of the instrument's sweep operation.

- If you have not selected a sweep type (Sweep Type is *None*), this is the screen that first appears.
- If you have already selected a sweep type, the sweep <*Control*> screen (page 3-71) is the first to appear.

Fig. 3-44 Main sweep

Sweep menu — <Config>

From this menu, you can:

- Define the parameter (frequency, RF level, modulation rate (R)) that is to be swept
- Define whether the sweep is to be continuous or single-shot
- Define how the sweep is controlled.

■*Sweep Type*

FREQ:MODE page 4-33
POW:MODE page 4-97

Use the numeric keypad to specify the parameter that is to be swept:

0	*None*	sweep disabled
1	*Freq*	sweep the carrier frequency
2	*Lev*	sweep the RF level

and then (depending on the chosen modulation) a selection from:

3–5	*Am1/2R*	sweep amplitude modulation rate
	Fm1/2R	sweep frequency modulation rate
	Pm1/2R	sweep phase modulation rate

■*Sweep Mode*

SWE:OPER page 4-102

Use the numeric keypad to specify the sweep mode:

0	*Single*	Single sweep. The sweep steps from the start value to the stop value and halts, displaying the stop value.
1	*Continuous*	Continuous sweep. The sweep steps from the start value to the stop value, and then repeats.

■*Ext Trig*

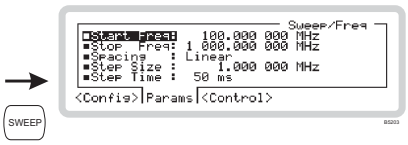
SWE:TRIG page 4-102

Use the numeric keypad to specify the external trigger mode:

0	*Off*	External trigger is disabled. Control the triggering manually using the sweep control screen of Fig. 3-46.
1	*Start*	The trigger starts the sweep. At the end of the sweep the trigger latch resets, ready for the next input. During the sweep, trigger inputs are ignored.
2	*Start/Stop*	The first trigger starts the sweep, the next trigger pauses it. A further trigger causes the sweep to resume from the point at which it paused. The trigger latch resets after each start/stop.
3	*Step*	Each trigger increments the sweep by the size of the frequency/level step. The trigger latch resets after each step.

The trigger input has a pull-up resistor, so a switch closure is treated as a trigger event.

***Note**: you can always control the sweep from the front panel, regardless of the trigger mode.*



Sweep menu — <Params>

From this menu, you can:

- Define the start and stop frequencies/levels of the sweep
- Define whether the sweep is to be linear or logarithmic (logarithmic only for RF sweep)
- Define the size of step
- Define the step duration.

From the sweep menu of Fig. 3-44, touch *<Params>* or press <TAB> to display the parameter selection screen (Fig. 3-45).

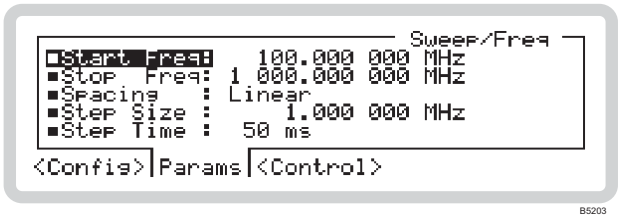


Fig. 3-45 Sweep parameter selection

■*Start Freq (Lev)*

FREQ:SWE:STAR page 4-36
POW:SWE:STAR page 4-99

Use the numeric keypad to specify the starting value for the sweep.

■*Stop Freq (Lev)*

FREQ:SWE:STOP page 4-37
POW:SWE:STOP page 4-100

Use the numeric keypad to specify the end value for the sweep.

■*Spacing*

FREQ:SWE:SPAC page 4-35

Use the numeric keypad to specify linear or logarithmic spacing of the step points.

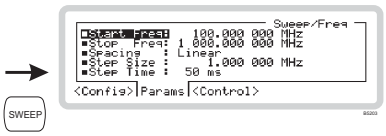
Note: *RF* level *sweep spacing is always logarithmic, with the step size specified in dB. For logarithmic* frequency *spacing, the value is expressed as a percentage and data entry is terminated with the* kHz % µV *key.*

■*Step Size*

FREQ:SWE:STEP page 4-36
POW:SWE:STEP page 4-99

Use the numeric keypad to specify the sweep step size.

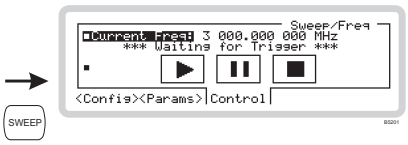
For linear step spacing, terminate with the appropriate units key. For logarithmic spacing, the value is presented as a percentage.



■*Step Time*

FREQ:SWE:DWEL page 4-34
POW:SWE:DWEL page 4-98

Use the numeric keypad to specify the duration of the step.



Sweep menu — <Control>

From this menu, you can start, stop and pause the sweep operation by touching 'soft boxes' on the screen. You can also alter the current frequency/level value.

From the sweep menu of Fig. 3-44, touch *<Control>* or press <TAB> to display the sweep control screen (Fig. 3-46).

Status messages show the current progress of the sweep: for example, ****Waiting for Trigger****, ****Sweep Completed****.

Fig. 3-46 Sweep control

■*Current Freq (Lev)*

FREQ:SWE:MAN page 4-35
POW:SWE:MAN page 4-98

This is highlighted whilst the sweep is inactive. Use the numeric keypad, control knob or the x10 and ÷10 keys to change the current frequency (level).

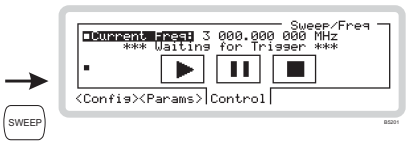
■ 1 2 3

The soft boxes are always available for touch operation. However, to operate the sweep from the numeric keypad you need to press the navigation key, which displays the numbers in the corners of the soft boxes.

1

SWE:INIT page 4-101

Touch the *Play* soft box to start a sweep. If the sweep is set to *Continuous* (*Sweep Mode*, page 3-68) the sweep continues indefinitely.



2

SWE:PAUS page 4-102

Touch the *Pause* soft box to stop the sweep. *Current Freq (Lev)* is highlighted, displaying the frequency/level step currently reached by the sweep. You can now use the 0 and 4 soft boxes to step the current frequency/level value backwards and forwards.

Touch 1 to continue the sweep.

0

SWE:AM:INT:SWE:MAN page 4-45

Whilst the sweep is paused, touch this soft box to decrease the current sweep frequency/level one step at a time. Step size is specified in the sweep parameter menu (page 3-69).

4

Whilst the sweep is paused, touch this soft box to increase the current sweep frequency/level one step at a time. Step size is specified in the sweep parameter menu (page 3-69).

3

SWE:ABOR page 4-102

Stop the sweep at any time by touching this soft box. The sweep halts and the current frequency/level resets to its start value.

Summary of sweep operation and status messages

START	Starts the sweep. The status line changes from ***WAITING FOR TRIGGER*** to ***SWEEPING***.
PAUSE	Stops the sweep at the current frequency/level step. The status message changes from ***SWEEPING*** to ***SWEEP PAUSED***. You can change the frequency/level value reached.
CONTINUE	Continues the sweep. In **continuous sweep** mode, the sweep automatically repeats from the start frequency/level. At the end of a **single sweep**, the stop value is displayed and the status message changes from ***SWEEPING*** to ***SWEEP COMPLETED***.
RESET	Discontinues the sweep and resets it to the start frequency/level. This selection is ignored when ***WAITING FOR TRIGGER***.

Memory

Save — saving configurations to memory

SYST:SETT:FULL:SAVE page 4-111

Press SAVE to see a complete summary of the current configuration of the instrument (for example, Fig. 3-47). You can save this configuration to memory. All the stores are non-volatile.

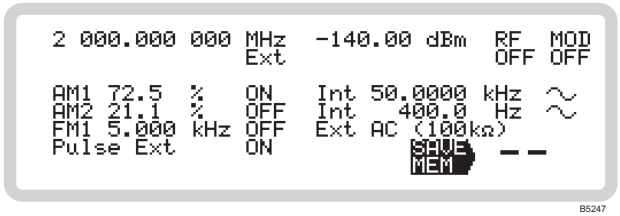


Fig. 3-47 Save

Enter the number of the memory store (0–99) to which you want to save the current instrument configuration and press ENTER to terminate.

Recall — retrieving stored settings from memory

SYST:SETT:FULL:REC page 4-111

Press RECALL to see a complete summary of the current configuration of the instrument (Fig. 3-47). From here, you can recall any previously stored instrument configuration, including factory pre-set defaults.

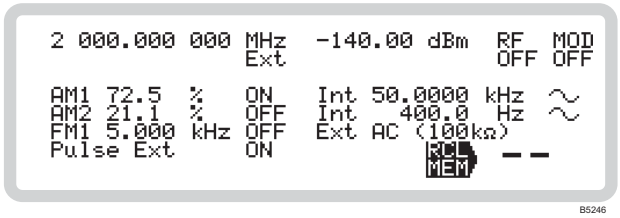


Fig. 3-48 Recall

Enter the number of the memory store (0–99), and press ENTER, to recall the chosen instrument configuration.

You can also use the control knob or x10 and ÷10 to step through the memory stores.

Factory default settings

Factory defaults settings are recalled differently to configurations that you have set yourself — see Table 3-2 on page 3-112.

Reverse power protection

Depending on the particular conditions, the reverse power protection circuit (RPP) may trip to protect the instrument when:

- External power is applied to the RF OUTPUT socket or
- No terminating load is attached to the RF OUTPUT socket and a high-level output is requested from the instrument.

The screen shown in Fig. 3-49 is displayed.

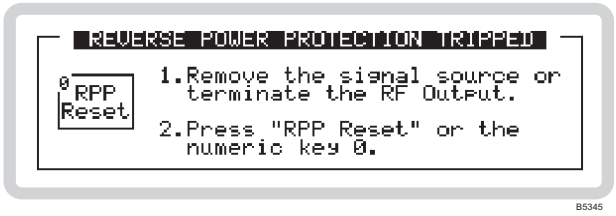


Fig. 3-49 RPP alert

Resetting the RPP

OUTP:PROT:CLE page 4-23

Remove the RF power source connected to the RF OUTPUT socket and touch the 0 RPP Reset soft box as requested. The display returns to the menu in use at the time that the RPP tripped.

The attenuator and instrument RPP trip counts are incremented and stored. The current value for the total number of operating hours is also stored.

Tip: *If the instrument trips because of a reverse power flow from the UUT, disconnect the UUT. Before resetting the RPP, make sure that you reduce the RF output; otherwise the instrument could trip again immediately the RPP is reset (high power, no termination).*

Error status

Press ERROR STATUS to see a screen (Fig. 3-50) that allows you to view the last 20 errors that have occurred, and clear the error list if necessary.

See page 3-113 for the listing of error messages.

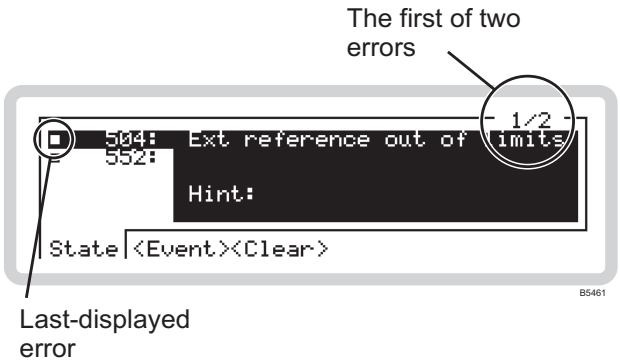


Fig. 3-50 Error status

<State>

Touch <*State*> to view state errors, which are generated because of an incorrect operating condition within the instrument. They are given numbers ≥500. The latest error to be displayed is shown by a solid box (■).

1 Numbers at the top right of the screen show the current error displayed, and the total number of errors logged.

2 Move up and down the list using the ↓ and ↑ navigation keys.

<Event>

Touch <*Event*> to view event errors, which are generally caused when an entered parameter is outside its valid range, or when an invalid operation is requested. Event errors can often be cleared by selecting the correct function or by re-entering the parameter correctly. The last error to be displayed is shown by a solid box (■).

Move up and down the list using the ↓ and ↑ navigation keys.

Touch <*Clear*> to display a screen that allows you to clear all displayed event errors (state errors are not cleared) (Fig. 3-51).

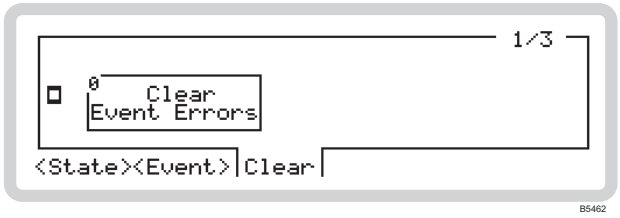


Fig. 3-51 Clear event errors

Touch the 0 Clear Event Errors soft box, or key **0**.

Fig. 3-52 Confirming clear event errors

- Cancel the request by pressing [-/←].
- Confirm by pressing ENTER — the event error list is cleared.

Remote operation

On receiving a valid command, the instrument switches automatically to remote operation. The display presents a complete summary of the current configuration of the instrument (for example, as in Fig. 3-53).

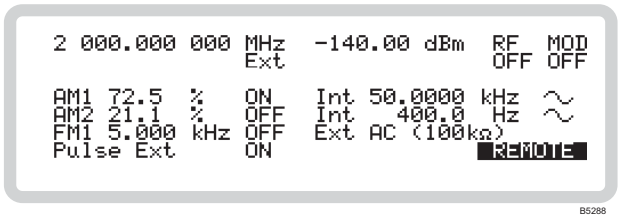
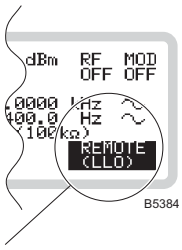


Fig. 3-53 Remote operation

Return to local operation

Press LOCAL to return the instrument to local operation.



Note: *if the controller has asserted Local Lockout (LLO), the* LOCAL *key is disabled. The instrument can then only be returned to local operation by the controller.*

UTILITIES

Press UTIL to see the main utilities screen (Fig. 3-54), from which you can set up all aspects of the instrument's configuration that are not directly concerned with making measurements[1].

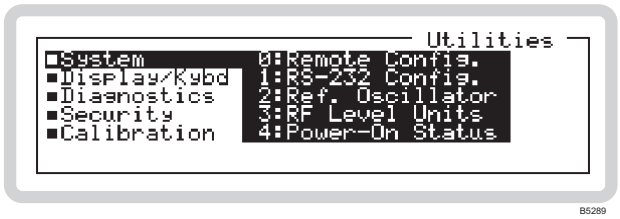


Fig. 3-54 Main utilities

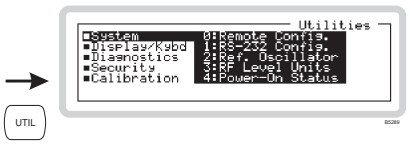
What you can do from this screen:

■***System***	remote/RS-232 configuration; SCPI/2023 language selection; reference oscillator; RF level units; power-on status (page 3-82).
■***Display/keyboard***	LCD adjustment; self-tests; screen blanking (page 3-92).
■***Diagnostics***	instrument status, operating time and build configuration; attenuator type; latch access (page 3-95).
■***Security***	locking/unlocking the instrument; clearing memory; locking the keyboard; choosing the reference oscillator (page 3-101).
■***Calibration***	last adjustment dates and last complete check date for synthesizer/reference oscillator; modulation and RF level (page 3-104).

Storing settings

Unless indicated otherwise, each time that you change a utility setting it is stored in non-volatile memory.

[1] This screen appears after power-on or an instrument preset (for example, *RST). But if you have already set up any utility parameter since power-on or preset, the last function selected appears.



■System

Get to the system utilities by scrolling on the *Utilities* main screen (Fig. 3-54).

Select a system utility using the numeric keypad:

0	*Remote Config.*	(this page)
1	*RS-232 Config.*	(page 3-84)
2	*Ref. Oscillator*	(page 3-86)
3	*RF Level Units*	(page 3-89)
4	*Power-On Status*	(page 3-90).

■System: Remote Config.

Press **0** on the numeric keypad to see the remote configuration screen (Fig. 3-55).

From this screen you can:

- Select the type of interface: GPIB or RS-232
- Select the programming language: SCPI or 2023
- Select the instrument's GPIB address.

Remote config. menu — <Interface>

SYST:COMM:REM page 4-105

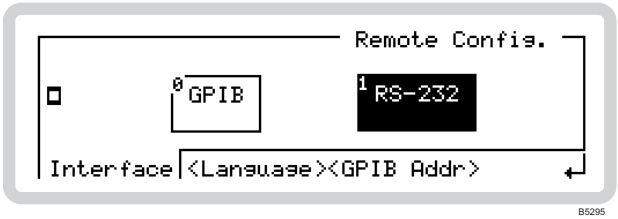
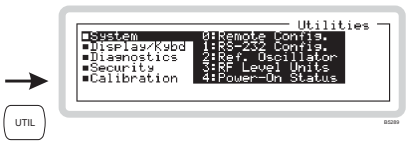


Fig. 3-55 Remote configuration — interface

Touch the appropriate soft box or press the equivalent numeric key to change the type of interface.



Remote config. menu — <Language>

SYST:LANG page 4-109

Touch <*Language*> or press <TAB> to display the language configuration screen (Fig. 3-56).

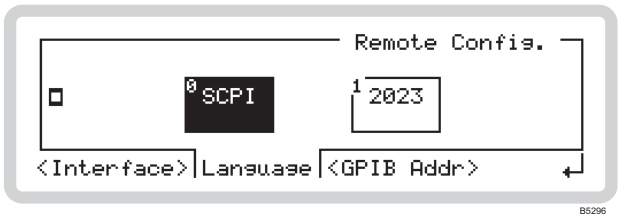


Fig. 3-56 Remote configuration — language

Touch the appropriate soft box or equivalent numeric key to select which command set is used:

- SCPI commands conform where possible to the SCPI standard
- 2023 supports the 2023 Series command set, including 2023 Series status reporting and error message handling.

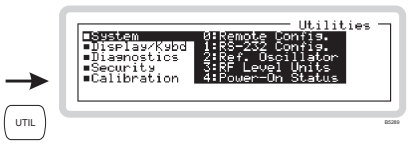
Remote config. menu — <GPIB Addr>

SYST:COMM:GPIB:ADDR page 4-105

Touch <*GPIB Addr*> or press <TAB> to display the GPIB address screen (Fig. 3-57).

Fig. 3-57 Remote configuration — GPIB address

Set the new GPIB address using the numeric keypad.



■System: RS-232 Config.

From this screen, you can set up RS-232 communication parameters. The RS-232 port is used for downloading upgrades to the instrument's firmware.

Press **1** on the numeric keypad to see the RS-232 configuration screen (Fig. 3-58).

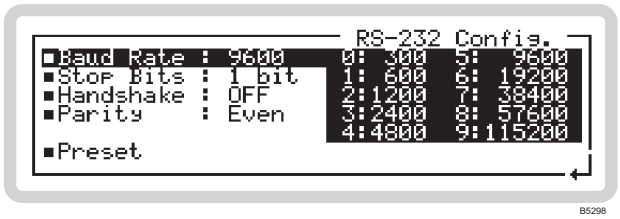


Fig. 3-58 RS-232 configuration

■*Baud Rate*

SYST:COMM:SER:BAUD page 4-106

Use the numeric keypad to specify the baud rate, in the range 300 to 115200 bit/s.

0	*300 bit/s*	**5**	*9600 bit/s*
1	*600 bit/s*	**6**	*19200 bit/s*
2	*1200 bit/s*	**7**	*38400 bit/s*
3	*2400 bit/s*	**8**	*57600 bit/s*
4	*4800 bit/s*	**9**	*115200 bit/s*

■*Stop Bits*

SYST:COMM:SER:SBIT page 4-107

Use the numeric keypad to specify the number of stop bits:

0 *1 bit*

1 *2 bits*

■*Handshake*

SYST:COMM:SER:CONT:HAND page 4-106

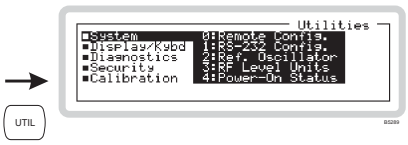
Use the numeric keypad to set hardware or software handshaking:

0 *OFF*

1 *H/W*

2 *S/W*

3 *BOTH*



■*Parity*

SYST:COMM:SER:PAR page 4-107

Use the numeric keypad to specify the parity:

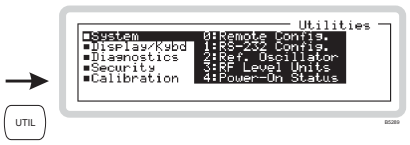
0 *None*

1 *Even*

2 *Odd*

■*Preset*

Press ENTER to restore the RS-232 settings to the default values of IEEE 1174.



■System: Ref. Oscillator

From this screen, you can select a 10 MHz output to provide a standard for associated equipment. You can also define a standard (external or internal) for use by the instrument. When an external standard is selected, the internal OCXO locks to it, and you can choose between **direct** and **indirect**:

- Direct: the internal standard for the instrument's RF section is provided directly from the external standard
- Indirect: the internal standard is provided from the OCXO, locked to the external standard.

If the instrument is unlocked (refer to page 3-101), you can manually adjust the reference oscillator's tuning value and save this to a non-volatile store.

Press **2** on the numeric keypad. If the instrument is locked, you see the internal reference oscillator screen shown in Fig. 3-59. If the instrument is unlocked, an additional soft tab (<*Adjust*>) is visible.

Ref. Oscillator menu — <Int Ref>

ROSC:SOUR page 4-27

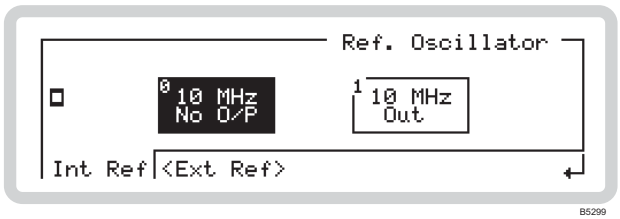
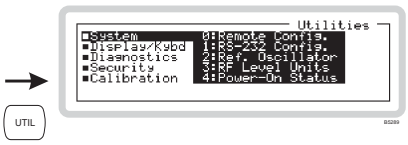


Fig. 3-59 Internal reference oscillator

Touch the appropriate soft box or equivalent numeric key to switch the 10 MHz internal reference output on or off. The signal is output at the FREQ STD IN/OUT socket.

If an external reference is selected, neither soft box is highlighted.



Ref. Oscillator menu — <Ext Ref>

Touch <*Ext Ref*> or press <TAB> to display the external reference selection screen (Fig. 3-60).

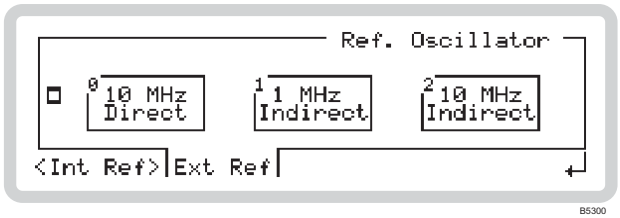


Fig. 3-60 External reference oscillator (instrument locked)

Touch the appropriate soft box or equivalent numeric key to select an external source type.

Connect the signal to the FREQ STD IN/OUT socket.

Tip: *You should select* Direct *if the external standard has significantly lower phase noise than that fitted in the instrument.*

Select Indirect *if you merely want a more accurate frequency standard.*

Adjusting the tuning offset

If the instrument is unlocked*, the additional <*Adjust*> soft tab appears (Fig. 3-61).

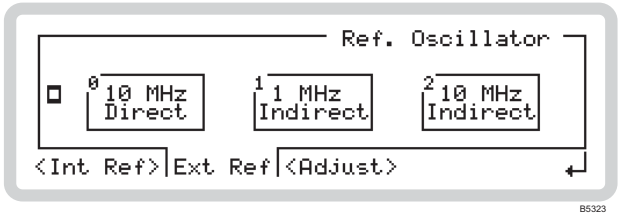
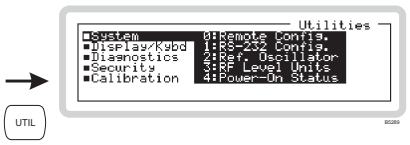


Fig. 3-61 External reference oscillator (instrument unlocked)

Touch <*Adjust*> or press <TAB> to display the tuning offset screen (Fig. 3-62).

* The tuning offset value is protected to the 'user password' level and the instrument needs to be unlocked before the tuning offset can be changed — see page 3-101.



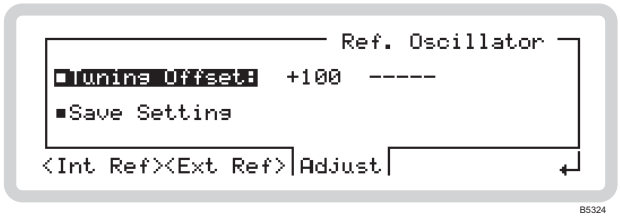


Fig. 3-62 Reference oscillator tuning offset

■*Tuning Offset*

ROSC:INT:ADJ page 4-26

The current tuning offset is displayed. This represents the deviation from the reference tuning value established during calibration.

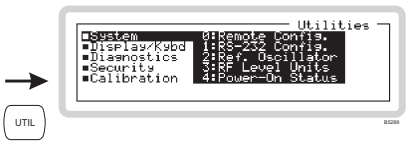
Change it using the numeric keypad, control knob or (x10) and (÷10) keys.

■*Save Setting*

ROSC:INT:ADJ:SAV page 4-26

Press ENTER to save the current tuning offset for use at the next power-on.

This new value does not overwrite the tuning value set during calibration.



■System: RF Level Units

From this screen, you can:

- Define the type of dB units for RF level
- Define whether output voltage is shown as EMF or PD.

Press **3** on the numeric keypad to see the RF level dB units screen (Fig. 3-63).

Ref. Level Units menu — <dB rel>

UNIT:POW page 4-114

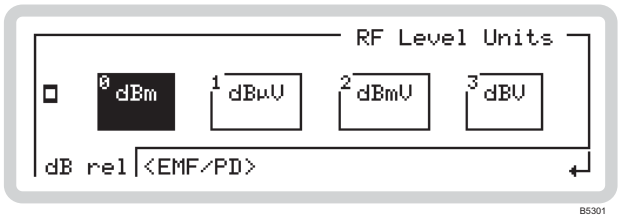


Fig. 3-63 RF level dB units

Touch the appropriate soft box or equivalent numeric key to select dB units.

Ref. Level Units menu — <EMF/PD>

UNIT:VTYP page 4-114

Touch <*EMF/PD*> or press <TAB> to display the output voltage selection screen (Fig. 3-64).

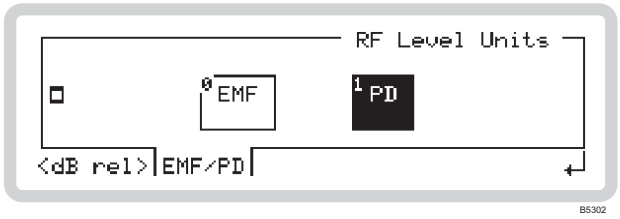
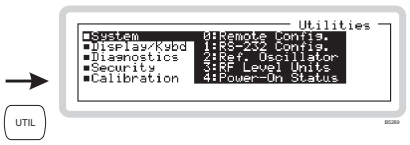


Fig. 3-64 RF level EMF/PD

Touch the appropriate soft box or equivalent numeric key to select output voltage source type.

- EMF: voltage generated into an open circuit
- PD: voltage generated across a 50 Ω load.



■System: Power-On Status

From this screen, you can:

- Define whether the instrument starts up from the factory default or a memory setting
- Define which memory location is used
- Force the instrument to adopt its preset hardware configuration (currently the same as factory default).

Press **4** on the numeric keypad to see the power-on status screen (Fig. 3-65).

Power-On Status menu — <Mode>

SYST:PON:TYPE page 4-110

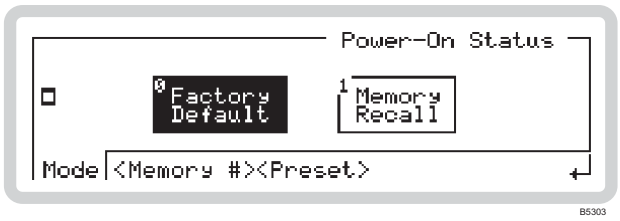


Fig. 3-65 Power-on mode

Touch the appropriate soft box or equivalent numeric key to define whether the instrument:

- Starts up with the factory default settings (page 3-112)
- Starts up from the memory location defined by <*Memory #*> below.

Power-On Status menu — <Memory #>

SYST:PON:MEM page 4-110

Touch <*Memory #*> or press <TAB> to display the memory recall screen (Fig. 3-66).

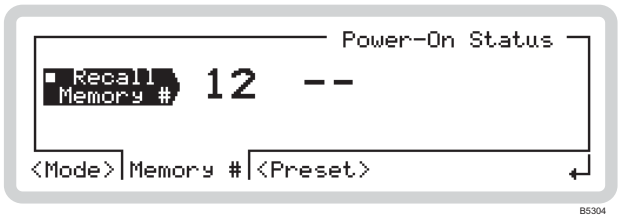
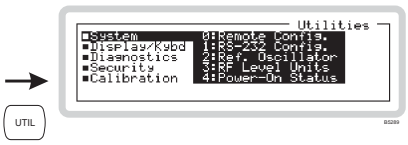


Fig. 3-66 Power-on memory recall

Enter the required memory location using the numeric keypad and press ENTER to terminate. This location is used to set up the instrument at power-on if *Memory Recall* is selected above.



Power-On Status menu — <Preset>

SYST:PRES page 4-110

This operation forces the instrument immediately to its factory default configuration, without altering its usual power-on configuration.

Touch <*Preset*> or press <TAB> to display the preset power-on screen (Fig. 3-67).

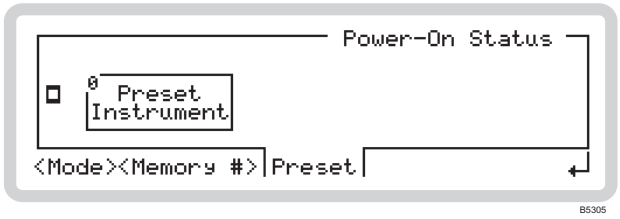


Fig. 3-67 Power-on preset

Touch the 0 Preset Instrument soft box or key **0** to request an instrument preset (Fig. 3-68).

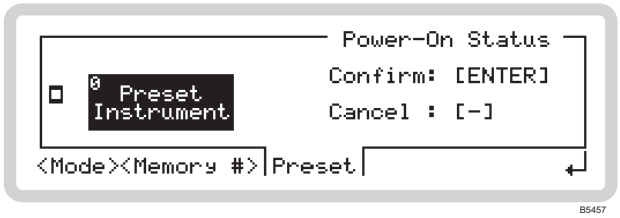
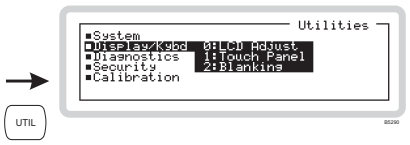


Fig. 3-68 Confirming power-on preset

- Cancel the request by pressing -
- Confirm by pressing ENTER — the instrument changes immediately to its factory default configuration (page 3-112).

Note that at the next power-on, the mode in which the instrument starts up is still determined by the Mode *setting on page 3-90.*



■Display/Kybd

Get to the display and keyboard utilities by scrolling on the *Utilities* main screen (Fig. 3-54).

Select a display/keyboard utility using the numeric keypad:

0 *LCD Adjust* (this page)

1 *Touch Panel* (page 3-93)

2 *Blanking* (page 3-93)

With these utilities, you can:

- Set the LCD's contrast
- Size and calibrate the touch screen
- Set up display blanking.

■Display/Kybd: LCD Adjust

Press **0** on the numeric keypad to see the LCD contrast adjustment screen (Fig. 3-69).

Fig. 3-69 LCD adjustment

■*Contrast*

The current contrast setting is displayed. Change it using the numeric keypad, control knob or x10 and ÷10 keys.

■*Save Setting*

DISP:CONT page 4-124

Press ENTER to save the current contrast setting for use at the next power-on.

■Display/Kybd: Touch Panel

Press **1** on the numeric keypad to see the first touch calibration screens (Fig. 3-70).

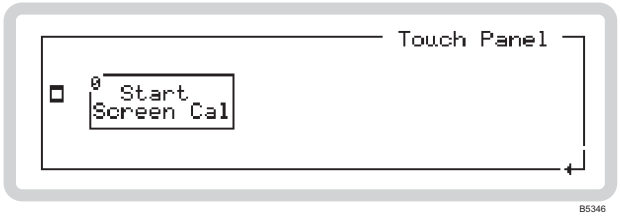


Fig. 3-70 Screen calibration, first screen

This utility recalibrates and checks the usable area of the touch screen. Follow the instructions that appear: you are asked to establish the limits of the touch area and then check the result by observing that the instrument locates accurately a random contact point. If this fails, you are given the opportunity to try again.

You may need to touch the screen for a little longer than usual before the instrument responds.

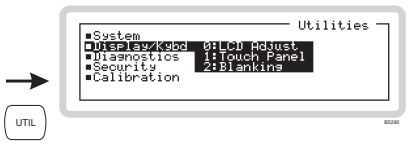
■Display: Blanking

DISP:ANN page 4-122

From this screen, you can instruct the instrument to display only asterisks (*) instead of digits (for reasons of security or sensitivity) in any of the following fields:

- Frequency
- RF level
- Modulation.

Press **2** on the numeric keypad to see the blanking screen (Fig. 3-71).



Blanking menu — <Freq>

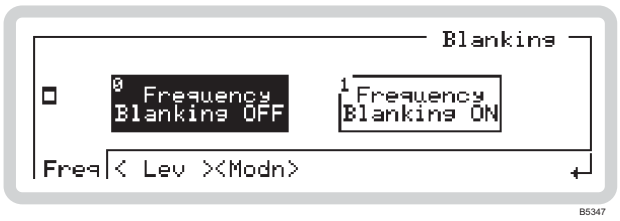


Fig. 3-71 Blanking menu (frequency)

Touch the appropriate soft box. Select frequency blanking *ON* and the main screen (press SIG GEN) looks like Fig. 3-72.

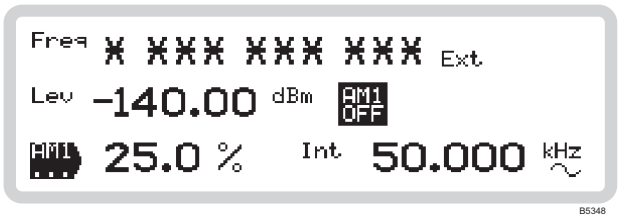


Fig. 3-72 Main screen with frequency field blanked

Blanking menu — <Lev> and <Modn>

Blank the level and modulation fields in the same way as for frequency. All modulation parameters appearing on the display are replaced by asterisks.

■Diagnostics

Get to the diagnostic utilities by scrolling on the *Utilities* main screen (Fig. 3-54).

Select a diagnostic utility using the numeric keypad:

0	*Inst. Status*	(this page)
1	*Operating Time*	(page 3-97)
2	*Build Config.*	(page 3-98)
3	*Latch Access*	(page 3-98)
4	*Attenuator*	(page 3-98)

■Diagnostics: Inst. Status

Press **0** on the numeric keypad to see the instrument status screen (Fig. 3-73).

From this screen, you can:

- View software and hardware status
- View which options are fitted
- View applicable patents.

Inst Status menu — <S/W>

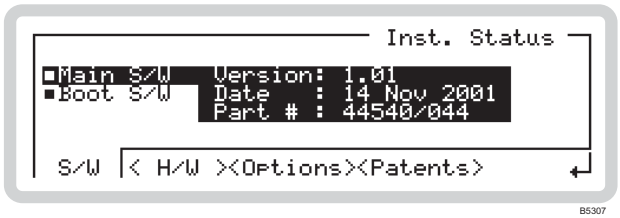


Fig. 3-73 Software status

You can view details of the instrument's software status:

version number

version date

version part number.

Inst Status menu — <H/W>

Touch <*H/W*> or press <TAB> to display the hardware status screen (Fig. 3-74).

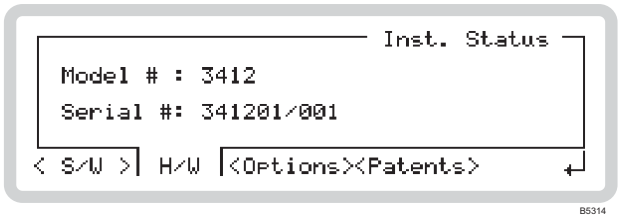


Fig. 3-74 Hardware status

You can view details of the instrument's hardware status:

model number

serial number.

Inst Status menu — <Options>

Touch <*H/W*> or press <TAB> to display the options screen (Fig. 3-75).

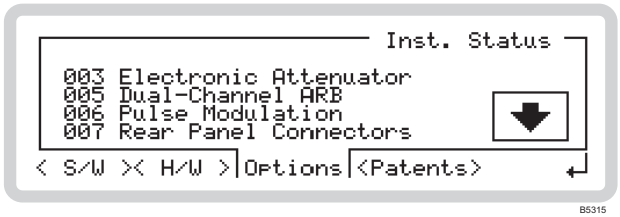


Fig. 3-75 Options

This shows which options (if any) are fitted to the instrument. If further options are fitted, a soft box is displayed. Touch this, or press ↓, to view these options.

Go back by touching the soft box or press ↑.

Inst Status menu — <Patents>

Touch <*H/W*> or press <TAB> to display the patents screen (Fig. 3-76).

You can view patents applicable to the instrument

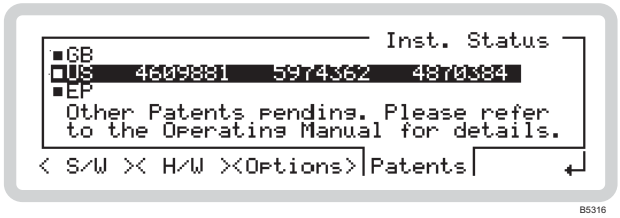


Fig. 3-76 Patents

■*GB*

View British patents.

■*US*

View US patents.

■*EP*

View European patents.

■Diagnostics: Operating Time

DIAG:INF:ETIM? page 4-119

Press **1** on the numeric keypad to see the instrument operating time screen (Fig. 3-73).

This screen shows the elapsed operating time since this value was last reset[1].

Fig. 3-77 Elapsed operating time

[1] Refer to the Maintenance Manual for information on how to reset the elapsed time counter.

■Diagnostics: Build Config.

From this screen, you can view the part number, serial number and build status for major sub-assemblies within the instrument.

Press **2** on the numeric keypad to see the build configuration screen (Fig. 3-78).

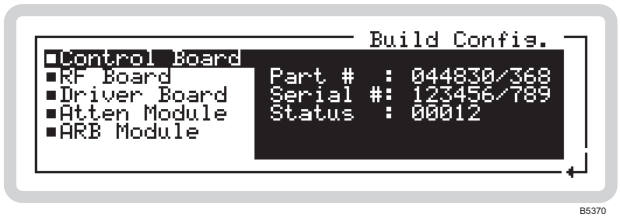


Fig. 3-78 Build configuration

■Diagnostics: Latch Access

From this screen, you can view and change the data that has been sent to latches within the instrument. This is a useful diagnostic aid during fault identification. It is protected by the user password.

For further information, refer to the Maintenance Manual.

■Diagnostics: Attenuator

From this screen, you can:

- View the type, part number and serial number of the attenuator
- View the number of times the RPP has tripped.
- View the attenuator pad values and switch the pads in or out.

Press **4** on the numeric keypad to see the attenuator status screen (Fig. 3-79).

Attenuator menu — <Details>

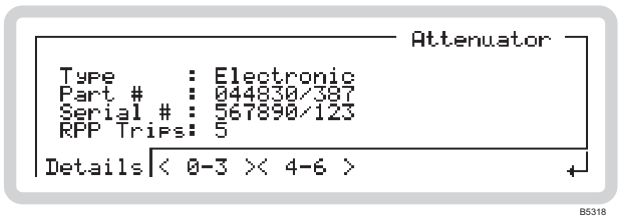


Fig. 3-79 Attenuator details

Attenuator menu — <0–3>

Touch *<0–3>* or press <TAB> to display the screen that shows details of attenuator pads 0 to 3 (Fig. 3-80).

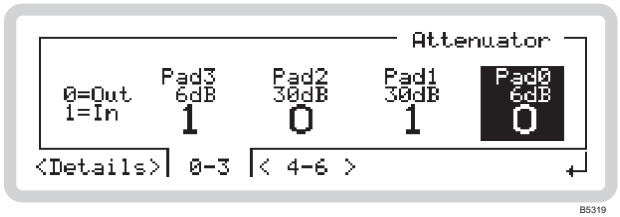


Fig. 3-80 Attenuator pads 0–3

Pads 0 to 3 are shown, each with its attenuation value and hardware (in/out) setting. The selected bit is highlighted.

- Select bits by pressing the x10 (move right) and ÷10 (move left) keys
- Press **0** or **1** on the numeric keypad to set the pad value.

Attenuator menu — <4–6>

Touch *<4–6>* or press <TAB> to display the screen that shows details of attenuator pads 4 to 6 (Fig. 3-80).

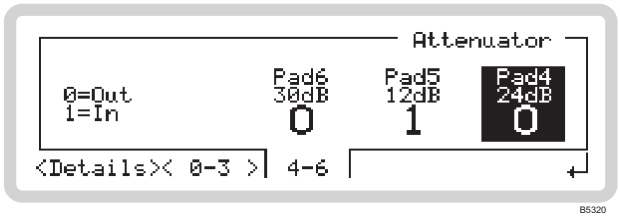
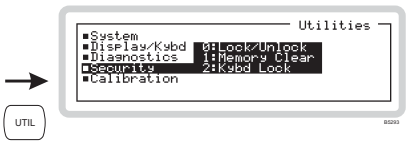


Fig. 3-81 Attenuator pads 4–6

Operation is the same as for pads 0 to 3.



■Security

A user password allows you to access protected utilities (see box).

Get to the security utilities by scrolling on the *Utilities* main screen (Fig. 3-54).

Select a security utility using the numeric keypad:

0 *Lock/Unlock* the whole instrument (this page)

1 *Memory Clear* (page 3-102)

2 *Kybd Lock* (page 3-103)

Protected by the user password

- Keyboard locking
- Memory clear
- Reference oscillator adjustment

Note: *this section deals with the **user password**. A more secure password, which allows additional diagnostic and hardware settings to be made, is reserved for administrators. Refer to the Maintenance Manual for details of the **administrator password**.*

■Security: Lock/Unlock

Press **0** on the numeric keypad to see the instrument's protection utility screen (Fig. 3-82).

From this screen, you can use the user password to lock and unlock the instrument in order to make adjustments to its set-up.

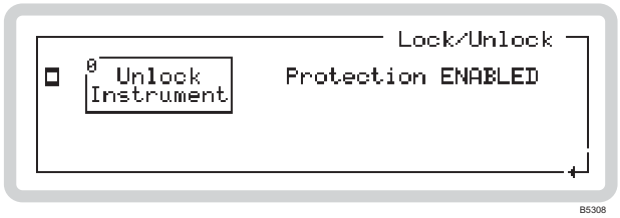


Fig. 3-82 Protection utility

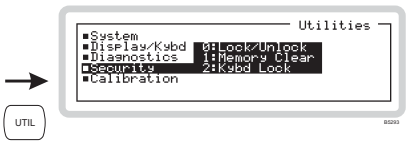
Instrument type	User password
3412	341201
3413	341301
3414	341401

1 Touch the 0 Unlock Instrument soft box or key **0**.

2 Enter the six-digit user password (see box). An asterisk appears as each digit is entered. Press ENTER to finish. The display shows *Protection DISABLED*.

3 You can now access the keyboard-locking facility, clear the memory and adjust the reference oscillator.

4 Touch the 0 Unlock Instrument soft box or key **0** again to re-establish protection for the instrument.



■Security: Memory Clear

SYST:SETT:FULL:CLE:ALL page 4-111

From this screen, you can erase the contents of all the user memory stores in one operation.

Press **1** on the numeric keypad to see the memory clear screen (instrument protection disabled) (Fig. 3-83). If the screen indicates that instrument protection is enabled, first remove the lock on the instrument (page 3-101).

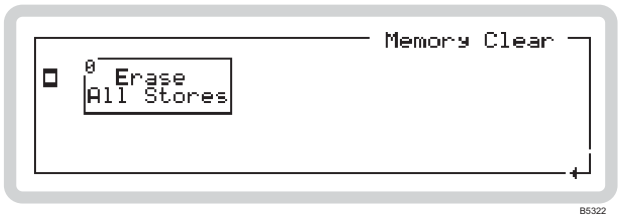
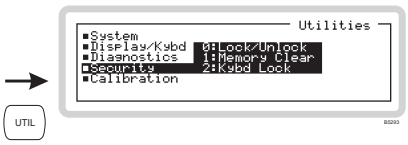


Fig. 3-83 Memory clear

Touch the 0 Erase All Stores soft box or key **0** to erase all the memory stores (Fig. 3-84).

Fig. 3-84 Confirming memory clear

- If you want to cancel the request, press [-]; otherwise:
- Confirm by pressing ENTER — the stores are erased and a confirmation message appears.



■Security: Kybd Lock

SYST:KLOC page 4-109

From this screen, you can lock or unlock most of the keys and the control knob.

Press **2** on the numeric keypad to see the keyboard locking screen (instrument protection disabled) (Fig. 3-85). If the screen indicates that instrument protection is enabled, first remove the lock on the instrument (page 3-101).

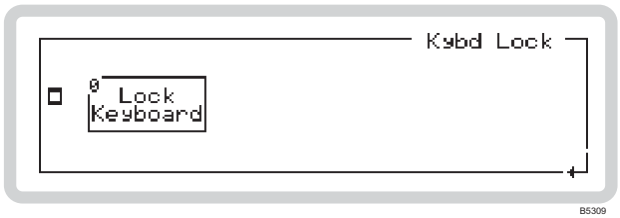


Fig. 3-85 Keyboard locking

Touch the 0 Lock Keyboard soft box or key **0** to lock the keyboard (Fig. 3-86).

Fig. 3-86 Confirming keyboard locking

- If you want to cancel the request, press [-]; otherwise:
- Confirm by pressing ENTER — the keyboard is locked and the display changes to show a summary of the instrument's set-up (Fig. 3-87). A 'key' symbol shows that the keyboard is locked. All controls (apart from the standby switch and the LOCAL key) are disabled.

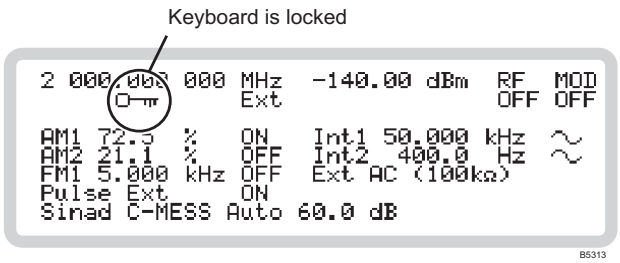
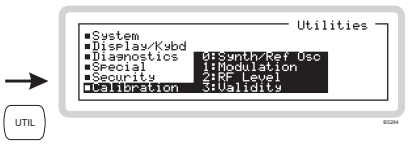


Fig. 3-87 Locked keyboard

Unlock the keyboard by entering the user password (for example, **341201**) on the numeric keypad, and press ENTER to terminate.



■Calibration

You can view the last date on which various parameters were adjusted, and also an overall 'last complete check' date.

Get to the calibration utilities by scrolling on the *Utilities* main screen (Fig. 3-54).

Select a calibration utility using the numeric keypad:

0	*Synth/Ref Osc*	display calibration dates (see box)
1	*Modulation*	display calibration dates (see box)
2	*RF Level*	display calibration dates (see box)
3	*Validity*	display the date of the last complete check.

View last calibration dates for the following:

Synth/Ref Osc

- VTF core presteer
- PLO presteer
- Reference oscillator

Modulation

- Modulation oscillator
- FM/FM
- AM
- External level monitor
- IQ path offset
- IQ overlap
- IQ modulator

RF Level

- Level reference offset
- Level reference
- Offset null
- RF tray
- RF system
- RF tray error
- ALC characterization
- Mode switch/ALC
- Burst modulator (fine)
- Burst modulator (frequency)

Validity

- Last complete check

SOFT FRONT PANEL

Soft front panel

The soft front panel, supplied on the CD-ROM accompanying the instrument, allows you to control a 3410 Series digital RF signal generator via its GPIB interface from a Windows 95 (or higher) or NT-compatible PC. You need a National Instruments GPIB interface card or equivalent. The soft front panel mimics operation of the front panel on the instrument, with mouse-clicks replacing touch operations.

You can also use the soft front panel as a stand-alone aid to training and to familiarize the user with how the instrument functions. No instrument or GPIB interface card is necessary to do this. The soft front panel still emulates all the keyboard controls and parameter setups but can not (for example) load ARB files or return errors.

Install and open the CD-ROM. Copy the *ifr3040sfp.exe* and *ifr3040sfp.uir* files to your hard drive and read the accompanying *readme* file. Double-click the *.exe* file to run it. The soft front panel, similar to that in Fig. 3-88, is displayed.

Fig. 3-88 Soft front panel

Operation

Operation from the soft front panel is very similar to operation from the instrument's front panel. The major difference is that the cursor replaces your finger on the screen, keys and control knob; also, there are some minor differences: for example, sweeping does not follow the instrument in real time. Generally however, the soft front panel (used together with a GPIB interface card) provides fast, accurate and realistic simulation of the instrument's front panel, with full return of error messages.

Loading ARB files

The soft front panel enables you to load any ARB (.aiq) file into the instrument (you can also do this using ***IQCreator***™ — see page 3-44). Press the ARB LOADER button to bring up the loading screen:

From here, you can view details of files already stored in the ARB (Catalog); delete files; or load files from another source. Pressing Load File brings up a standard Windows file access screen that lets you import stored .aiq files into the ARB.

QUICK REFERENCE TO FUNCTIONS

This section takes you quickly to a particular parameter or function using a 'shorthand' description of the route.

Conventions:

SIG GEN	Hard keys are shown like this.
Freq ...	'Function labels' reveal further sub-menus once you touch them.
<FM>	Soft tabs, which appear at the foot of the screen, are shown in brackets and italics.
RF Level	Text appearing on the screen is shown in italics.
Int AM1	'Soft boxes' expand to reveal summarized information about the named function once you touch them.
↓ ↑	Use these keys to scroll up and down the menu choices.
ENTER	Press this (any of the four units keys) to terminate each entry from the numeric keypad or the control knob.

If you get lost: press SIG GEN to return to the main screen.

Carrier	
Carrier frequency	SIG GEN Freq ... ↵ ... *<Freq>* ■ *Carr Freq:*
Phase sensitivity (carrier)	SIG GEN Freq ... ↵ ... *<Phase>* ■ *Sensitivity:*
Phase shift (carrier)	SIG GEN Freq ... ↵ ... *<Phase>* ■ *Phase Shift:*
Set 0° ref (carrier)	SIG GEN Freq ... ↵ ... *<Phase>* ■ *Set 0°Ref:*
RF level	
ALC bandwidth	SIG GEN Lev ... ↵ ... *<ALC>* ■ *ALC B/W:*
ALC mode	SIG GEN Lev ... ↵ ... *<ALC>* ■ *ALC Mode:*
Attenuation (RF offsets)	SIG GEN Lev ... ↵ ... *<Offsets>* ■ *Attenuation:*
Attenuator hold	SIG GEN Lev ... ↵ ... *<Lev>* ■ *Att Hold:*
Gain (RF offsets)	SIG GEN Lev ... ↵ ... *<Offsets>* ■ *Gain:*
Level (RF)	SIG GEN Lev ... ↵ ... *<Lev>* ■ *RF Level:*
Limit (RF)	SIG GEN Lev ... ↵ ... *<Lev>* ■ *Limit:*
Noise mode	SIG GEN Lev ... ↵ ... *<Lev>* ■ *RF Mode:*
Offsets	SIG GEN Lev ... ↵ ... *<Offsets>*
Status (RF offsets)	SIG GEN Lev ... ↵ ... *<Offsets>* ■ *Status:*
System loss (RF offsets)	SIG GEN Lev ... ↵ ... *<Offsets>* ■ *System Loss:*

Sweep	
Current frequency (sweep)	SWEEP <*Control*> ■ *Current Freq:*
Decrease step size (sweep)	SWEEP <*Control*> 0 ◀◀
External trigger (sweep)	SWEEP <*Config*> ■ *Ext Trig:*
Increase step size (sweep)	SWEEP <*Control*> 4 ▶▶
Pause sweep	SWEEP <*Control*> 2 ❚❚
Play sweep	SWEEP <*Control*> 1 ▶
Spacing (sweep)	SWEEP <*Params*> ■ *Spacing:*
Start frequency (sweep)	SWEEP <*Params*> ■ *Start Freq:*
Step size (sweep)	SWEEP <*Params*> ■ *Step Size:*
Step time (sweep)	SWEEP <*Params*> ■ *Step Time:*
Stop frequency (sweep)	SWEEP <*Params*> ■ *Stop Freq:*
Stop sweep	SWEEP <*Control*> 3 ■
Sweep mode	SWEEP <*Config*> ■ *Sweep Mode:*
Sweep type	SWEEP <*Config*> ■ *Sweep Type:*

Modulation

For all modulation types, first select the modulation mode. For example:

internal AM: [ANALOG MOD] [1 Int AM1] or

internal IQ: [IQ MOD] [2 Int IQ] .

Substitute AM1/2, FM1/2, ΦM1/2, internal IQ or external IQ as needed in the following descriptions.

AM1 depth	[ANALOG MOD] [1 Int AM1] [SIG GEN] [AM1 . . .] [↵ . . .] *<AM1> ■ AM1 Depth:*
AM1 state	[ANALOG MOD] [1 Int AM1] [SIG GEN] [AM1 . . .] [↵ . . .] *<AM1> ■ AM1 State:*
AM1 internal source	[ANALOG MOD] [1 Int AM1] [SIG GEN] [AM1 . . .] [↵ . . .] *<Int Source>*
AM1 external source	[ANALOG MOD] [1 Int AM1] [SIG GEN] [AM1 . . .] [↵ . . .] *Ext Source>*
Alternative level (burst attenuation)	[SIG GEN] [Burst . . .] [↵ . . .] *<Alt Level>*
Burst attenuation	[SIG GEN] [Burst . . .] [↵ . . .] *<Alt Level> ■ Burst Atten:*
Burst profile	[SIG GEN] [Burst . . .] [↵ . . .] *<Burst> ■ Profile:*
Fall time (burst profile)	[SIG GEN] [Burst . . .] [↵ . . .] *<Burst> ■ Fall Time:*
Rise time (burst profile)	[SIG GEN] [Burst . . .] [↵ . . .] *<Burst> ■ Rise Time:*
Source (burst attenuation control)	[SIG GEN] [Burst . . .] [↵ . . .] *<Alt Level> ■ Source:*
Trigger interval (burst alignment)	[SIG GEN] [Burst . . .] [↵ . . .] *<Align> ■ Trigger Interval:*
Burst offset	[SIG GEN] [Burst . . .] [↵ . . .] *<Align> ■ Burst Offset:*
Burst duration Δ	[SIG GEN] [Burst . . .] [↵ . . .] *<Align> ■ Burst Duration Δ:*
Burst state	[SIG GEN] [Burst . . .] [↵ . . .] *<Burst> ■ Source:*
FM1 deviation	[ANALOG MOD] [FM1] [SIG GEN] [FM1 . . .] [↵ . . .] *<FM1> ■ FM1 Devn:*
FM1 state	[ANALOG MOD] [FM1] [SIG GEN] [FM1 . . .] [↵ . . .] *<FM1> ■ FM1 State:*
ΦM1 deviation	[ANALOG MOD] [ΦM1] [SIG GEN] [ΦM1 . . .] [↵ . . .] *<ΦM1> ■ ΦM1 Devn:*
ΦM1 state	[ANALOG MOD] [ΦM1] [SIG GEN] [ΦM1 . . .] [↵ . . .] *<ΦM1> ■ ΦM1 State:*
Pulse modulation state	[ANALOG MOD] [Pulse] [SIG GEN] [Pulse . . .] [↵ . . .] *<Pulse> ■ Pulse State:*
External IQ modulation state	[IQ MOD] [1 Ext IQ] [SIG GEN] [IQ . . .] [↵ . . .] *<IQ> ■ IQ State:*
External IQ modulation impedance	[IQ MOD] [1 Ext IQ] [SIG GEN] [IQ . . .] [↵ . . .] *<IQ> ■ Impedance:*
External IQ modulation self-calibration inititate	[IQ MOD] [1 Ext IQ] [SIG GEN] [IQ . . .] [↵ . . .] *<IQ> ■ Self-Cal:*
External IQ modulation self-calibration mode	[IQ MOD] [1 Ext IQ] [SIG GEN] [IQ . . .] [↵ . . .] *<Config Cal> ■ Mode:*
External IQ modulation self-calibration operating mode	[IQ MOD] [1 Ext IQ] [SIG GEN] [IQ . . .] [↵ . . .] *<Config Cal> ■ Operation:*
Internal IQ modulation state	[IQ MOD] [2 Int IQ] [SIG GEN] [IQ . . .] [↵ . . .] *<IQ> ■ IQ State:*
Internal IQ modulation self-calibration inititate	[IQ MOD] [2 Int IQ] [SIG GEN] [IQ . . .] [↵ . . .] *<IQ> ■ Self-Cal:*
Internal IQ modulation ARB waveform details	[IQ MOD] [2 Int IQ] [SIG GEN] [IQ . . .] [↵ . . .] *<W'form>*
Internal IQ modulation self-calibration mode	[IQ MOD] [2 Int IQ] [SIG GEN] [IQ . . .] [↵ . . .] *<Config Cal> ■ Mode:*
Internal IQ modulation self-calibration operating mode	[IQ MOD] [2 Int IQ] [SIG GEN] [IQ . . .] [↵ . . .] *<Config Cal> ■ Operation:*

ARB	
Waveform control	[IQ MOD] [2 Int IQ] [SIG GEN] [W'form ...] [↵ ...] *<Control>*
Current waveform display	[IQ MOD] [2 Int IQ] [SIG GEN] [W'form ...] [↵ ...] *<Config>* ■ *Current W'form:*
Tuning offset	[IQ MOD] [2 Int IQ] [SIG GEN] [W'form ...] [↵ ...] *<Config>* ■ *Tuning Offset:*
RMS	[IQ MOD] [2 Int IQ] [SIG GEN] [W'form ...] [↵ ...] *<Config>* ■ *RMS:*
Play mode	[IQ MOD] [2 Int IQ] [SIG GEN] [W'form ...] [↵ ...] *<Config>* ■ *Mode:*
Trigger mode	[IQ MOD] [2 Int IQ] [SIG GEN] [W'form ...] [↵ ...] *<Config>* ■ *Trigger:*
View waveforms	[IQ MOD] [2 Int IQ] [SIG GEN] [W'form ...] [↵ ...] *<Catalog>*
Internal source	
Frequency	[SIG GEN] [Int ...] [↵ ...] *<AM1/FM1/ΦM1 Source>* ■ *Int Freq:*
Waveshape	[SIG GEN] [Int ...] [↵ ...] *<AM1/FM1/ΦM1 Source>* ■ *Int Shape:*
Phase difference	[SIG GEN] [Int ...] [↵ ...] *<AM2/FM2/ΦM2 Source>* ■ *Phase Diff:*
Rotary control sensitivity	[SIG GEN] [Int ...] [↵ ...] *<AM2/FM2/ΦM2 Source>* ■ *Sensitivity:*
External source	
Coupling	[SIG GEN] [Ext ...] [↵ ...] *<AM1/FM1/ΦM1 Source>* ■ *Coupling:*
DC FM null	[SIG GEN] [Ext ...] [↵ ...] *< FM1 Source>* ■ *DCFM Null:*
Impedance	[SIG GEN] [Ext ...] [↵ ...] *<AM1/FM1/ΦM1 Source>* ■ *Impedance:*
Sensitivity	[SIG GEN] [Ext ...] [↵ ...] *<AM1/FM1/ΦM1 Source>* ■ *Sensitivity:*
Memory	
Save to memory	[SAVE]
Recall from memory	[RECALL]
Remote operation	
Interface	[UTIL] ■ *System* **0** *<Interface>*
Language	[UTIL] ■ *System* **0** *<Language>*
GPIB address	[UTIL] ■ *System* **0** *<GPIB Addr>*
RS-232 configuration	[UTIL] ■ *System* **1**
Reference oscillator	
Internal	[UTIL] ■ *System* **2** *<Int Ref>*
External	[UTIL] ■ *System* **2** *<Ext Ref>*
Units	
RF level	[UTIL] ■ *System* **3** *<dB rel>*
RF voltage	[UTIL] ■ *System* **3** *<EMF/PD>*

Power-on	
Mode	UTIL ■ *System* **4** *<Mode>*
Memory store number	UTIL ■ *System* **4** *<Memory #>*
Preset instrument	UTIL ■ *System* **4** *<Preset>*
Display settings	
Display contrast	UTIL ■ *Display/Kybd* **0**
Touch screen calibration	UTIL ■ *Display/Kybd* **1**
Display blanking	UTIL ■ *Display/Kybd* **2**
Instrument diagnostics	
Software status	UTIL ■ *Diagnostics* **0** *<S/W>*
Hardware status	UTIL ■ *Diagnostics* **0** *<H/W>*
Fitted options	UTIL ■ *Diagnostics* **0** *<Options>*
Patent information	UTIL ■ *Diagnostics* **0** *<Patents>*
Elapsed operating time	UTIL ■ *Diagnostics* **1**
Build configuration	UTIL ■ *Diagnostics* **2**
Attenuator details	UTIL ■ *Diagnostics* **4** *<Details>*
Attenuator pads 0–3	UTIL ■ *Diagnostics* **4** *<0–3>*
Attenuator pads 4–6	UTIL ■ *Diagnostics* **4** *<4–6>*
Lock/unlock instrument	UTIL ■ *Security* **0**
Clear memory	UTIL ■ *Security* **1**
Lock/unlock keyboard	UTIL ■ *Security* **2**

Default settings

The instrument resets to the factory default settings in the following cases:

- At power-on (unless you have stored a different power-on memory location — see page 3-90)
- After a *Preset Instrument* operation (page 3-91)
- After the ***RST** command.

Table 3-2 Default settings

Carrier frequency: Step :	(Maximum available) 2 GHz/3 GHz/4 GHz 1 kHz
RF level: Step:	–140 dBm 1 dB Status: OFF
Modulation mode:	Internal FM, modulation disabled
Modulations:	FM1: Deviation: 0 Hz, ON Internal source, frequency: 1 kHz, sine FM2: Deviation: 0 Hz, ON Internal source, frequency: 400 Hz, sine ΦM1: Deviation: 0 rad, ON Internal source, frequency: 1 kHz, sine ΦM2: Deviation: 0 rad, ON Internal source, frequency: 400 Hz, sine AM1: Deviation: 0%, ON Internal source, frequency: 1 kHz, sine AM2: Deviation: 0%, ON Internal source, frequency: 400 Hz, sine Pulse: ON
External source:	AC coupled, 50 Ω
MOD ON/OFF	ON
SOURCE ON/OFF	ON for all modulation parameters
Modulation steps:	ΔFM 1 kHz, ΔΦM 0.1 rad, ΔAM 1%
Mod frequency steps:	10 Hz
Carrier sweep: Freq mode: Mode: Type: Ext trigger: Start: Stop: Step size: Time:	 Fixed Single sweep Linear Off 250 kHz (Maximum available) 1 kHz 50 ms

Error messages

0	No error

Query errors

Occur when an attempt is made to read data from the output queue when no output is present or pending, or when data has been lost.

–430	Query DEADLOCKED
–420	Query UNTERMINATED
–410	Query INTERRUPTED
–403	Stream error
–402	Stream disconnect
–401	Device clear
–400	Query error

Command errors

Occur when a message received from the controller does not comply with the IEEE 488.2 standard, or an unrecognized header is received.

–178	Expression data not allowed
–168	Block data not allowed
–161	Invalid block data
–158	String data not allowed
–151	Invalid string data
–148	Character data not allowed
–144	Character data too long
–141	Invalid character data
–140	Character data error
–138	Suffix not allowed
–134	Suffix too long
–131	Invalid suffix
–128	Numeric data not allowed
–124	Too many digits
–123	Exponent too large
–121	Invalid character in number
–120	Numeric data error

–113	Undefined header
–112	Program mnemonic too long
–111	Header separator error
–110	Command header error
–109	Missing parameter
–108	Parameter not allowed
–105	GET not allowed
–104	Data type error
–103	Invalid separator
–102	Syntax error
–101	Invalid character
–100	Command error

Execution errors

Occur when a received parameter is outside its allowed range or inconsistent with the instrument's capabilities, or when the instrument does not execute a valid program message properly due to some device condition.

–257	File name error
–256	File not found
–254	Media (memory) full
–253	Corrupt media (memory)
–223	Too much data
–222	Data out of range
–221	Settings conflict
–200	Execution error
100	Carrier limit
101	Carrier step limit
102	RF level limit
103	RF level step limit
104	Invalid modulation mode
105	AM1 limit
106	AM2 limit
107	AM1 step limit
108	AM2 step limit
109	FM1 limit
110	FM2 limit
111	FM1 step limit
112	FM2 step limit

113	PM1 limit
114	PM2 limit
115	PM1 step limit
116	PM2 step limit
118	AM1 frequency limit
119	AM1 frequency step limit
120	AM2 frequency limit
121	AM2 frequency step limit
122	FM1 frequency limit
123	FM1 frequency step limit
124	FM2 frequency limit
125	FM2 frequency step limit
126	PM1 frequency limit
127	PM1 frequency step limit
128	PM2 frequency limit
129	PM2 frequency step limit
134	Sweep time limit
135	Sweep mode disabled
136	Carrier phase limit
156	Offset limit
168	Swept value limited by start/stop
169	Manual sweep setting not allowed
170	Log step limit
171	Logarithmic sweep start/stop cannot be zero
173	Rise time limit
174	Fall time limit
175	Carrier phase step limit
176	Modulation phase difference limit
177	RTime limit
178	FTime limit
179	Burst offset limit
180	Duration delta limit
181	BurstAtten limit
300	Invalid cal store format
301	Invalid settings store
302	ARB waveform format error
303	ARB internal error
304	ARB checksum error
305	ARB verification error
306	ARB tuning offset limit
307	Options store error

308	Inconsistent latch information
311	Option not present
406	Invalid ARB sector
514	RF level limited by user limit
515	FM1 limited by freq
550	RF level limited by AM
551	AM2 limited by AM1
552	FM2 limited by freq/FM1
553	PM2 limited by PM1

Device errors

Occur when a device operation does not complete properly, possibly due to an abnormal hardware or firmware condition.

–350	Queue overflow
–321	Out of memory
–310	Non-unique command added to table
–300	Device-specific error
–1	Unknown error
309	Invalid store catalog detected
310	Store checksum failure
400	No calibration data on EEPROM
401	DSP is out of space for calibration data
402	ARB not present
403	ARB booted from backup image
404	ARB control failure
405	ARB file system not initialized
407	Device initialization error
496	DSP handshaking timed out
497	DSP received an invalid message header
498	DSP received an invalid message body
499	DSP sent an invalid message header
500	RPP tripped
501	Fractional-N loop low
501	Fractional-N loop out of limits
502	Fractional-N loop high
503	Ext standard missing
504	Ext standard too low
504	Ext standard out of limits

505	Ext standard too high
506	800 MHz PLO low
507	800 MHz PLO out of limits
509	Output unleveled
511	ALC too high
512	ALC too low
517	Ext AM out of limits
518	Ext FM out of limits
519	Ext PM out of limits
520	ARB PLL out of limits
521	OCXO out of limits
522	Power supply failure
523	ARB DACs not in sync

2023 emulation

This instrument can be configured easily (page 3-82) to respond to many commands originally written for IFR2023 Series AM/FM signal generators (IFR2023, 2024, 2023A, 2023B and 2025). The following is a list of 2023 Series commands that are emulated by 3410 Series instruments. For details of the commands, refer to the appropriate operating manual: part no. 46882/225 for IFR2023 and 2024; part no. 46882/373 for IFR2023A, 2023B and 2025.

***Note**:*

Status reporting is returned in 2023 format.

*Common commands and * commands are as standard 2023 Series.*

**RST resets the instrument to 2023 Series defaults.*

BLANK
CONTRAST
ELAPSED?
ELAPSED:RESET
ERASE:ALL
ERROR?
FSTD
GPIB
KLOCK
KUNLOCK
OPER?
POWUP:MEM
POWUP:MODE
RCL?
RCL:DN
RCL:MEM
RCL:UP

AM[:DEPTH]
AM:Dn
AM:EXTAC
AM:EXTDC
AM:Inc
AM:INT
AM:MODF:Dn
AM:MODF:Inc
AM:MODF:PHASE
AM:MODF:Retn
AM:MODF:SIN
AM:MODF:SQR
AM:MODF:TRI
AM:MODF:Up
AM:MODF[:VALUE]
AM:MODF:Xfer
AM:OFF
AM:ON
AM:Retn
AM:Up
AM:Xfer

AM2[:DEPTH]
AM2:Dn
AM2:EXTAC
AM2:EXTDC
AM2:Inc
AM2:INT
AM2:MODF:Dn
AM2:MODF:Inc
AM2:MODF:PHASE
AM2:MODF:Retn
AM2:MODF:SIN
AM2:MODF:SQR
AM2:MODF:TRI
AM2:MODF:Up
AM2:MODF[:VALUE]
AM2:MODF:Xfer
AM2:OFF
AM2:ON
AM2:Retn
AM2:Up

AM2:Xfer

ATTEN:LOCK
ATTEN:UNLOCK

CFRQ:Dn
CFRQ:Inc
CFRQ:Retn
CFRQ:Up
CFRQ[:VALUE]
CFRQ:Xfer

DCFMNL
FM[:DEVN]
FM:Dn
FM:EXTAC
FM:EXTDC /
FM:Inc
FM:INT
FM:MODF:Dn
FM:MODF:Inc
FM:MODF:PHASE
FM:MODF:Retn
FM:MODF:SIN
FM:MODF:SQR
FM:MODF:TRI
FM:MODF:Up
FM:MODF[:VALUE]
FM:MODF:Xfer
FM:OFF
FM:ON
FM:Retn
FM:Up
FM:Xfer

FM2[:DEVN]
FM2:Dn
FM2:EXTAC
FM2:EXTDC
FM2:Inc
FM2:INT
FM2:MODF
FM2:MODF:Dn
FM2:MODF:Inc
FM2:MODF:PHASE
FM2:MODF:Retn
FM2:MODF:SIN
FM2:MODF:SQR
FM2:MODF:TRI
FM2:MODF:Up
FM2:MODF[:VALUE]
FM2:MODF:Xfer
FM2:OFF
FM2:ON
FM2:Retn
FM2:Up
FM2:Xfer

MOD:OFF
MOD:ON
MODE

PM[:DEVN]
PM:Dn
PM:EXTAC
PM:Inc
PM:INT
PM:MODF:Dn
PM:MODF:Inc
PM:MODF:PHASE
PM:MODF:Retn
PM:MODF:SIN
PM:MODF:SQR
PM:MODF:TRI
PM:MODF:Up
PM:MODF[:VALUE]
PM:MODF:Xfer
PM:OFF
PM:ON
PM:Retn
PM:Up
PM:Xfer

PM2[:DEVN]

PM2:Dn/nquery/
PM2:EXTAC/nquery/
PM2:Inc
PM2:INT/nquery/
PM2:MODF:Dn
PM2:MODF:Inc
PM2:MODF:PHASE
PM2:MODF:Retn
PM2:MODF:SIN
PM2:MODF:SQR
PM2:MODF:TRI
PM2:MODF:Up
PM2:MODF[:VALUE]
PM2:MODF:Xfer
PM2:OFF
PM2:ON
PM2:Retn
PM2:Up
PM2:Xfer

PULSE:OFF
PULSE:ON

RFLV:Dn
RFLV:Inc
RFLV:OFF
RFLV:ON
RFLV:Retn
RFLV:Up
RFLV[:VALUE]
RFLV:Xfer

RPP:COUNT?
RPP:RESET
RPP:TRIPPED?

STO:MEM

SWEep:CFRQ:INC
SWEep:CFRQ:LOGInc
SWEep:CFRQ:START
SWEep:CFRQ:STOP
SWEep:CFRQ:TIME
SWEEP:CONT
SWEep:GO
SWEep:HALT
SWEep:MODe
SWEep:RESet
SWEep:TRIGger
SWEep:TYPE

:CCR?
:CSE
:CSR?
:HCR?
:HSE
:HSR?
:SCR?
:SSE
:SSR?

:HELP? gives a list of 2023 commands accepted by the instrument. It is not itself a 2023 command.

Format of ARB files

General

The ARB stores digital representations of waveforms. Up to 180 different waveforms can be stored, each capable of holding 131 072 samples. The memory used is non-volatile, ensuring that information is retained when the power is switched off.

Each waveform consists of two components, I and Q. When the ARB is enabled and one of the waveforms selected, it is converted into a pair of analog signals that can be used to drive the I and Q channels of the RF modulator. Waveform data files are created externally and require packaging before they can be used by the ARB.

The ARB memory can be divided into 180 equal subsectors. A waveform occupies one or more subsectors depending on the number of samples in the waveform.

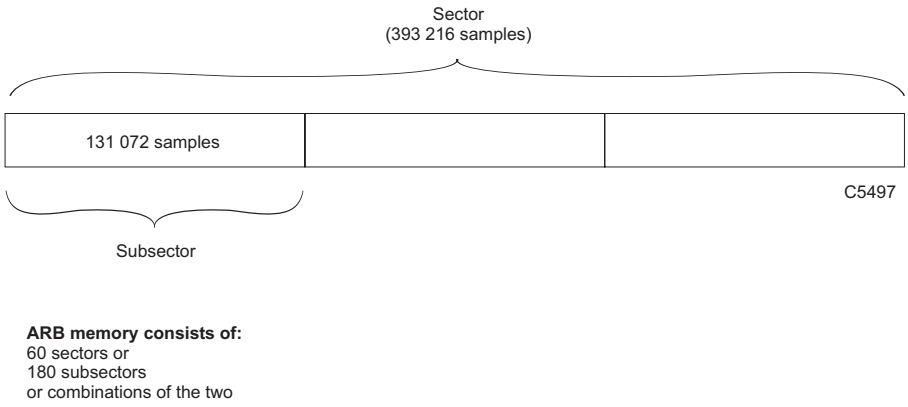


Fig. 3-89 ARB memory allocation

If the ARB is to store 180 waveforms, each must be no more than 131 072 samples long. Each sample contains two 14-bit numbers, one each for I and Q.

Each symbol (or chip in the case of CDMA) must be represented by at least four ARB samples of the waveform in order for it to be reconstructed correctly. To minimize the required file size and reduce aliasing problems, the ARB includes an interpolator to increase the D-A converter sample rate by factors of between 2 and 3072 so that the D-A converter runs at between 44 and 66 M sample/s. Unless the waveform to be generated is a narrow-band signal there is little technical merit in increasing the number of samples in the ARB file to more than four samples per symbol or chip.

A waveform is looped continuously. The rate at which the sample plays is set during file creation.

An example showing data rates and sizes for an IS-95 waveform

IS-95 has a chip rate of 1.2288 Mchip/s. For our purposes we will consider a chip to be the significant symbol. Each symbol must be sampled at least four times. This would give a rate of 4.9152 Msample/s. There are 24 576 symbols per 20 ms frame. Four frames would have 98 304 symbols, which after oversampling gives 393 216 samples.

Such a file would occupy one sector of memory; the ARB can store 60 such files.

If each symbol was sampled more than four times the output data rate would be different and the file larger. Fewer such files could be stored.

When the above waveform is selected and played, it is read out of the memory at 4.9152 Msample/s. The ARB interpolates this data stream so that it has a data rate of 58.9824 Msample/s.

The data is written to the two 14-bit D-A converters at 58.9824 Msample/s. The analog outputs from the D-A converters are then filtered to remove switching and quantization noise and high-frequency images. The I and Q outputs are then routed to the RF modulator.

Markers

Markers are used to mark important events within the file; for example, the location of a burst, the start of a TDMA slot or frame.

Format for header of ARB IQ files (*.AIQ)

	Comment	No. of bytes
[File]		
Date=	Date file was created (mm/dd/yyyy)	12
Time=	Time file was created (hh:mm:ss)	10
PackSWVers=nn.nn	SW version of Packager (user files must set nn.nn = 00.00)	5
Samples=	No. of IQ Samples as an ASCII number	8
Title=	Name of AIQ file without extension and without path	80
SampleRate=	In Hz, in steps of 100 Hz, converted from user entry in packager	8
Description=	Description field entered in packager	120
RMS=	RMS value of the stored waveform	9
RelRMS=	RMS relative to maximum (dB)	8
CrestFactor=	Crest factor of stored waveform	8
LevelMode=	Instrument level mode	9[1]
SymbolRate=	Symbol rate in Hz (may be used to set leveling loop bandwidth)	8

[1] Allowed values are IQScaled and IQDefault. The default should be IQDefault.

The remaining sections are only placed in the header if markers are used:

	Comment	No. of bytes
[Ramp]		
Delay=	Max delay in samples (may convert from time in packager)	6
UpProfile=	Up ramp profile type	4[1]
DownProfile=	Down ramp profile type	42
UpProfDur=	Up profile duration in samples	6
DownProfDur=	Down profile duration in samples	6
AltLevel=	The alternate level in dB (0 to 70 dB in 0.01 dB steps)	5
[Assign]		
Mkr1=	Marker 1 assignment (Power ramp)	12[2]
Mkr2=	Marker 2 assignment (amplitude)	12[3]
Mkr3=	Marker 3 assignment	12[3]
Mkr4=	Marker 4 assignment	12[3]

All headers are stored as ASCII strings, each line terminated with CR/LF.

The header is terminated by a ^Z. Data following the header is the IQ and marker data stored as IQIQIQ…

The format is:

bit number	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
	S	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	M4	M3

bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	S	I	I	I	I	I	I	I	I	I	I	I	I	I	M2	M1

where Mn = marker number n, S = sign bit.

The last 32-bit value in the file is a checksum that is calculated as the running unsigned sum of the 32-bit numbers.

[1] Allowed types are: cos2, gaus, fast.

[2] Allowed assignments are: NotUsed, Ramp (Mkr1 only), Level (Mkr2 only), Gen.

Chapter 4
REMOTE OPERATION

Contents

REMOTE OPERATION COMMANDS

Introduction

This instrument may be operated remotely via an interface that conforms to:

IEEE Std 488.1-1987, which defines the electrical, mechanical and low-level protocol characteristics of the bus structure, the GPIB (General Purpose Interface Bus)

IEEE Std 488.2-1987, which defines standard codes, formats, protocols and common commands for use with IEEE Std 488.1.

The instrument is not fully compliant with SCPI (Standard Commands for Programmable Instruments) because many product features are not covered by that standard, and modern software trends favor the use of instrument drivers as a means of achieving interchangeability.

However, we recognize that SCPI is in common use by system developers and a number of SCPI features that make system integration easier have been implemented. These include the extended status reporting structure, the error numbering scheme, the command mnemonic derivation rules (long and short form), and many of the most frequently used commands themselves. Refer to SCPI 1997 for details.

Where to find commands

Commands are grouped into particular subsystems on the following pages, as shown in the Contents. Under each heading is an overview of the commands within that subsystem, which will help you quickly locate commands by function. Commands are arranged alphabetically within subsystems.

You will also find cross-references to individual commands from the operating instructions of Chapter 3 and from the Index.

Parameter ranges

Refer to the performance data in Chapter 1 for valid ranges for parameters.

CONVENTIONS USED IN THIS MANUAL

Abbreviations

Long and short forms

The elements of compound and query headers have a long and a short form, as defined by SCPI. Either the long or the short form may be entered as a command; other abbreviations are not permissible.

Example:

```
STATus:OPERation:EVENt?
```

is interpreted the same as

```
STAT:OPER:EVEN
```

The short form is marked by upper-case letters, the long form corresponds to the complete word. Upper-case and lower-case serve the above purpose only, as the instrument itself does not make any distinction between upper-case and lower-case letters.

Queries always return the short form, or a numeric response in those cases where the command provides a choice of numeric or character data.

Bracketed elements

Square brackets [ ]

Elements within the compound common program header structure that are enclosed within square brackets are optional and therefore may be omitted; the instrument processes the command in the same manner whether the bracketed element is included or not.

Example:

```
[SOURce:]POWer[:LEVel][:IMMediate][:AMPlitude]
```

is interpreted the same as

```
POWer
```

This applies to parameters also. The ability to recognize the full command length ensures that the instrument complies with the SCPI standard in this respect.

Curly brackets { }

Parameters included within curly brackets may be included any number of times or not at all.

Angle brackets < >

Text within angle brackets represents an actual value that needs to be inserted: for example, `<freq>` shows that you need to insert a frequency value in the command at this point.

Case

The software is not case-sensitive. Upper- and lower-case characters are completely interchangeable. There is no conflict between milli (m) and mega (M) as both cannot be applied to the same data.

Choices

The vertical bar (|)

- separates a choice of parameters:

  for example, 0 | 1 means '0 or 1'

  or

- separates a choice of commands:

  for example, the vertical bar in `[SOURce][:MODulation]:AM[1]|2[:DEPTh]` means that you can set the AM depth for either path 1 or path 2 (path 1 is the default): the short-form versions of the commands are `AM` or `AM2`.

Compound program headers

Compound program headers allow a complex set of commands to be built up from a smaller set of basic elements in a tree structure. The elements of a compound program header are separated by a colon (:), each colon representing a change of level in the hierarchy. Each subsystem in this instrument is organized as a separate tree structure.

The compound program header may, optionally, be followed by one or more parameters encoded as program data functional elements.

Example:

```
OUTput:ATTenuation:AUTO 0
```

***Note**: a leading colon is optional*

Program data

Program data functional elements contain the parameters related to the program header(s). The following program data functional elements are accepted by the instrument:

<CPD>	(also known as <CHARACTER PROGRAM DATA>)
<NRf>	(also known as <DECIMAL NUMERIC PROGRAM DATA>)
<numeric_value>	(defined by SCPI)
<STRING PROGRAM DATA>	
<Boolean>	(defined by SCPI)
<ARBITRARY BLOCK PROGRAM DATA>	

These functional elements are defined in IEEE 488.2 and the SCPI Syntax and Style handbook.

A white space must separate the command header(s) and the program data.

<white space>, as defined in IEEE Std 488.2, can be any number of ASCII characters in the range 0–9, 11–32 decimal.

<white space> is also allowed at other points in a message.

<CPD>

Character program data is used to set a parameter to one of a number of states that are best described by short alphanumeric strings.

Example:

ON

<NRf>

Flexible numeric representation covers integer and floating-point representations.

Examples:

–466	Integer value
4.91	Explicitly-placed decimal point
59.5E+2	Mantissa and exponent representation

The format is known as ‘flexible’ because any of the three representations may be used for any type of numeric parameter.

Examples:

Where a parameter requires an integer value in the range 1 to 100, and the user needs to set its value to 42, the following values are accepted by the instrument:

42	Integer
42.0	Floating point
4.2E1, 4200E–2	Floating point – mantissa/exponent
41.5	Rounded up to 42
42.4	Rounded down to 42

<numeric_value>

<numeric_value> is a superset of <NRf> and <CPD>, used when parameters may consist of either a decimal value or the shorthand notations MAXimum or MINimum.

Example:

`FREQ:STEP` has a <numeric_value> parameter. This means that valid values for the step size may be the frequency value in Hz (for example, 250E+3), or MAXimum or MINimum.

<STRING PROGRAM DATA>

String program data consists of a number of ASCII characters enclosed in quotes. Use either pairs of single (ASCII 39) or double (ASCII 34) quotes, but do not mix single and double in a string. A quote within a string must be enclosed within an extra pair of quotes.

Example:

'This string contains the word ' 'Hello' ' '

is interpreted as

This string contains the word 'Hello'

and

"This string contains the word " "Hello" " "

is interpreted as

This string contains the word "Hello".

<Boolean>

<Boolean> is used as shorthand for the form ON | OFF | <NRf>. Boolean parameters have a value of 0 or 1 and are unitless.

On input, an <NRf> is rounded to an integer and a nonzero result is interpreted as 1.

<CPD> elements ON and OFF are accepted as inputs, with ON corresponding to 1 and OFF corresponding to 0. Queries return 1 or 0, never ON or OFF.

Examples:

ON is interpreted as 1

0.4 is interpreted as 0

2.8 is interpreted as 1

<ARBITRARY BLOCK PROGRAM DATA>

Definite format

Arbitrary block program data consists of 8-bit data bytes (DAB), preceded by ASCII header bytes that define the number of data bytes following, in the form

#<non-zero digit><digit><DAB><DAB><DAB><DAB>...

where ASCII character # introduces the block program data

<non-zero digit> is a single ASCII-encoded byte (in the range 31–39) that defines the number of <digit> elements

<digit> is one or more ASCII-encoded bytes (in the range 30–39) that define the number of data bytes following.

Examples:

`#14<DAB><DAB><DAB><DAB>`	represents four 8-bit bytes of data.
`#3128<DAB>..(128 times)..<DAB>`	represents 128 8-bit bytes of data.

During the transmission of data bytes, the instrument is instructed to ignore control characters, as it is possible that some combinations of data bytes might otherwise appear to be random control characters.

Indefinite format

The instrument also accepts the indefinite format, with an undefined number of 8-bit bytes of data

#0<DAB><DAB><DAB>...<DAB>NL^END

which forces an immediate termination of the program message.

Response data

The following response data functional elements are generated by the instrument:

<CRD> (also known as <CHARACTER RESPONSE DATA>)
<NR1>
<NR2>
<NR3>
<STRING RESPONSE DATA>

<CRD>

This type of response is returned when reading the value of a parameter that can take a number of discrete states. States are represented by short alphanumeric strings.

Example:

ON

<NR1>

This type of numeric response is used when returning the value of integer parameters, such as an averaging number or the number of measurement points.

Examples:

15
+3
−57

<NR2>

This type of numeric response includes an explicitly placed decimal point, but no exponent.

Examples:

17.91
−18.27
+18.83

<NR3>

This type of numeric response includes an explicitly placed decimal point and an exponent.

Examples:

1.756E+2
182.8E−3

<STRING RESPONSE DATA>

This takes a similar form to <STRING PROGRAM DATA> except that the delimiting character is always a double quote (“ASCII 34”).

<DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>

This takes a similar form to <ARBITRARY BLOCK PROGRAM DATA>.

Example:

```
#206<DAB><DAB><DAB><DAB><DAB><DAB>
```

represents six 8-bit bytes of returned data.

Terminators

A **<PROGRAM MESSAGE TERMINATOR>** (as defined in IEEE 488.2) can be a newline character (ASCII 10), a newline character with the ^END message asserted at the same time, or an ^END message asserted with the final character of the <PROGRAM MESSAGE>. The terminator may be preceded by any number of 'white space' characters — any single ASCII–encoded byte in the ranges 0 to 9 and 11 to 32 decimal.

A **<RESPONSE MESSAGE TERMINATOR>** (as defined in IEEE 488.2) is a newline character with the ^END message asserted at the same time.

Many GPIB controllers terminate program messages with a newline character and, by default, accept newline as the response message terminator. When transferring binary data, which may contain embedded newline characters, ensure that the controller uses only ^END messages. Usually this means that the controller's GPIB must be set up to generate and detect ^END. Refer to the documentation supplied with the controller.

Common commands

(Common commands subsystem)

Commands recognized by all IEEE 488.2 instruments

The common commands are taken from the IEEE 488.2 standard. These commands have the same effect on any instrument that conforms to the standard. The headers of these commands consist of an asterisk (*) followed by three letters. Many common commands refer to the status reporting system.

The most important of the common commands is *RST, which places the instrument in a defined state. It is good practice to send *RST at the start of any program.

***CLS**
***ESE\?**
***ESR?**
***IDN?**
***OPC\?**
***OPT?**
***RST**
***SRE\?**
***STB?**
***TST?**

*CLS

Description: Clear status clears the standard event register, the error queue, the operation event register and the questionable event register.

Parameters: None.

*ESE

Description: The event status enable command sets the standard event status enable register to the value specified. This is an eight-bit register.

Parameters: <NRf>
Mask.

Valid values: Mask: integer. Valid values are 0 to 255. Values outside range are rejected and an error generated.

*ESE?

Description: Reads the event status enable register. This is an eight-bit register. The contents of the event status enable register are returned in decimal form.

Parameters: None.

Response: <NR1>
Mask.

Returned values: Mask: integer. Values are in the range 0 to 255.

*ESR?

Description: Reads the value of the standard event status register. This is an eight-bit register. The contents of the register are returned in decimal form. Subsequently the register is set to zero.

Parameters: None.

Response: <NR1>
Register contents.

Returned values: Register contents: integer. Values are in the range 0 to 255.

*IDN?

Description: The identification query command allows information about the instrument to be read.

Parameters: None.

Response: <arbitrary ASCII response data>
Manufacturer, model, serial number, software part number and issue number

Returned values: Manufacturer: string
Always returns 'IFR'.

Model: string
This is the instrument's model number in the form 341x *where:*

341x	**Description**
3412	2 GHz Vector Signal Generator
3413	3 GHz Vector Signal Generator
3414	4 GHz Vector Signal Generator

Serial number: string
This is in the form ssssss/sss *where* s *is an* ASCII *digit in the range* 0 to 9.

Software part number and issue number: string
This is in the form ppppp/ppp/ii.ii *where* p *and* i *are* ASCII *digits in the range* 0 to 9.

*OPC

Description: The operation complete command sets the operation complete bit (bit 0) in the standard event status register when execution of the preceding operation is complete. This bit can be used to initiate a service request.

*OPC should be the final <program message unit> of the <program message>.

Parameters: None.

*OPC?

Description: The operation complete query returns a '1' when the preceding operation has completed.

*OPC? should be the final <query message unit> of the <program message>.

Parameters: None.

Response: <NR1>
Operation complete.

Returned values: Operation complete: integer. Value is 1.

*OPT?

Description: Reads hardware options present. If no options are present a single '0' is returned, otherwise the response is up to six strings separated by commas.

Parameters: None.

Response: <arbitrary ASCII response data>
Options.

Returned values: Option 001 – No Attenuator
Option 002 – Mechanical Attenuator
Option 003 – Electronic Attenuator
Option 005 – Dual-Channel ARB
Option 006 – Pulse Modulation
Option 007 – Rear Panel Outputs
Option 008 – Real-Time Baseband
Option 020 – 2G CDMA License
Option 021 – 2G & 3G CDMA License

*RST

Description: Resets the instrument to a known configuration appropriate for remote operation: see page 3-112.

Parameters: None.

*SRE

Description: Sets the service request enable register. This is an eight-bit register.

Parameters: <NRf>
Mask.

Valid values: Mask: integer. Valid values are 0 to 255. Values outside range are rejected and an error is generated.

*SRE?

Description: Reads the service request enable register. This is an eight-bit register.

Parameters: None.

Response: <NR1>
Mask.

Returned values: Mask: integer. Values are in the range 0 to 255.

*STB?

Description: Reads the status byte. This is an eight-bit register.

Parameters: None.

Response: <NR1>
Status byte.

Returned values: Status byte: integer. Values are in the range 0 to 255.

*TST?

Description: Self test query. Returns a '0' when the remote operation interface and processor are operating correctly.

Parameters: None.

Response: <NR1>
Self test completed.

Returned values: Self test completed: integer. Value is 0.

Output control commands

(OUTPut subsystem)

Mod. source on/off, RPP, RF on/off

Commands for:

- Turning each modulation path on or off
- Querying the state of, and resetting, RPP
- Turning the RF output on or off.

The OUTput subsystem effectively controls the switching of modulation paths within the instrument. Fig. 4-1 on page 4-19 is a representation of the `OUTput` and `SOURce` commands and their relationship to the sources. You can see from this that the `OUTput` commands control the outputs of the sources as well as the combined modulation output.

Not shown on this diagram is the `OUTput[:POWer][:STATe]` command, which controls the instrument's final RF output.

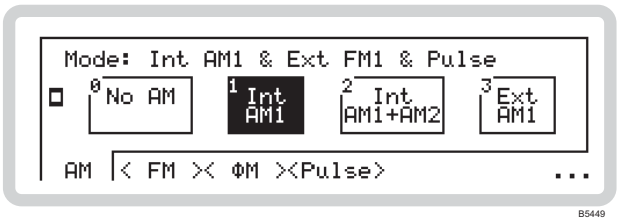
Note that this diagram is intended to show the effect of commands on the routing of sources and modulation paths, and does not necessarily represent actual hardware in the instrument.

OUTPut
:MODulation Enable/disable modulation...
:AM[1]|2
[:STATe]\? ...AM
:BURst
[:STATe]\? ...burst
:FM[1]|2
[:STATe]\? ...FM
:IQ
[:STATe]\? ...IQ
:PM[1]|2
[:STATe]\? ...phase
:PULM
[:STATe]\? ...pulse
[:STATe]\? ...all
[:POWer]
:PROTection Reverse power protection
:CLEar
:TRIPped?
[:STATe]\?

Why do we have the [SOURce][:MODulation]:<modn>:STATe and OUTput:MODulation:<modn>[:STATe] commands?

The **[SOURce][:MODulation]:<modn>:STATe** command allows you to make individual sources active to provide the overall modulation that you need.

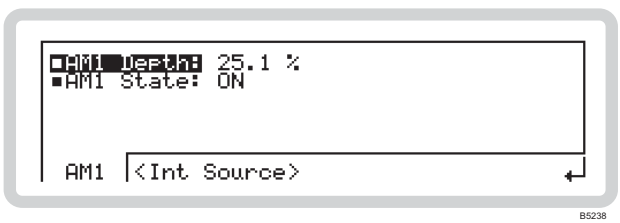
For example, [SOURce][:MODulation]:AM:STATe corresponds to the [1 Int AM1] soft box:



and provides SCPI-like control of modulation.

The **OUTput:MODulation:<modn>[:STATe]** command allows you to switch individual sources on or off without affecting the modulation mode that you have created.

For example, OUTput:MODulation:AM[:STATe] corresponds to *AM State* in the AM1 sub-menu:



and has the same effect as the SOURCE ON/OFF key on the front panel.

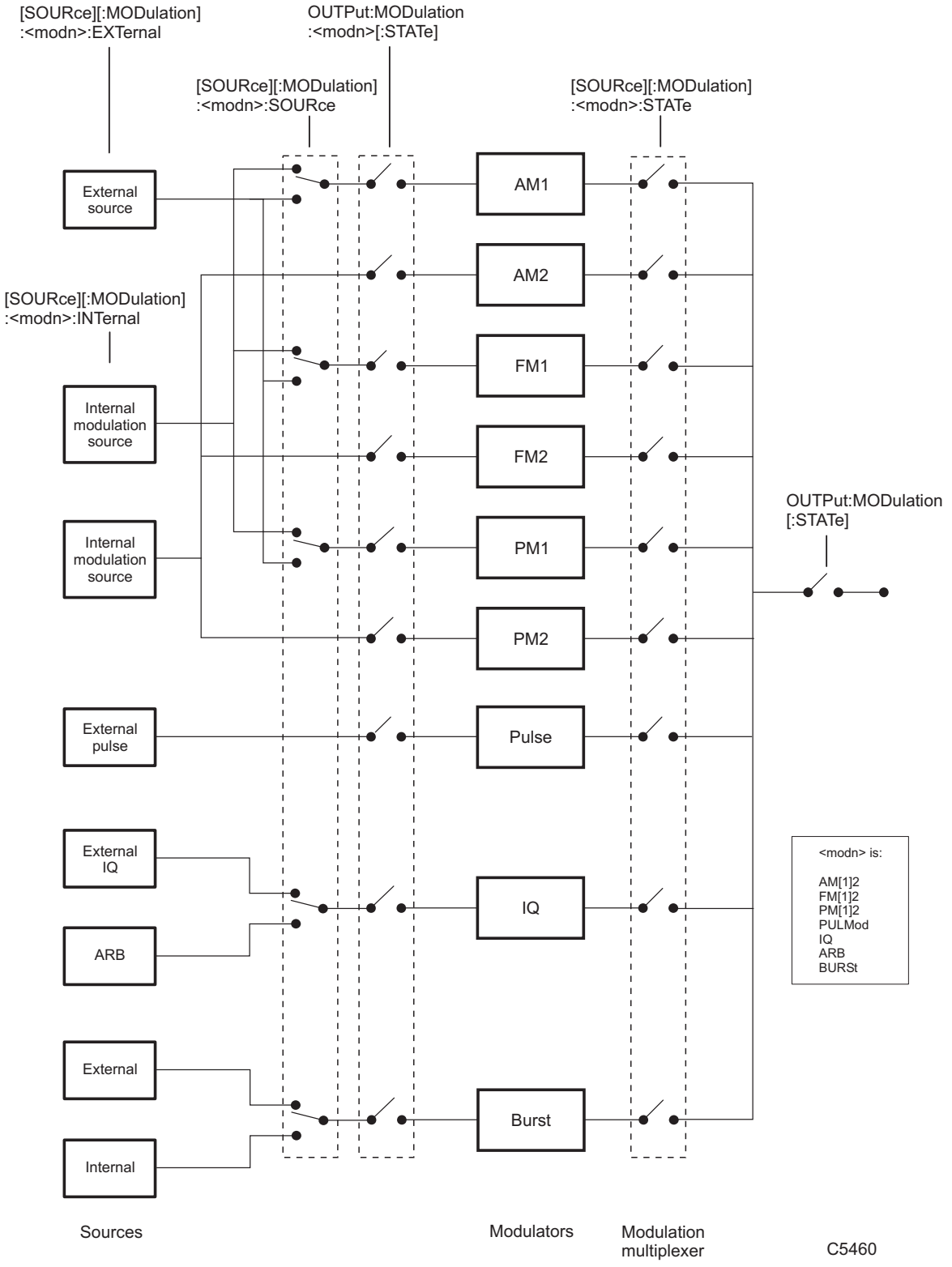


Fig. 4-1 Modulation generator switching

OUTPut:MODulation:AM[1]|2[:STATe]

Description: Turns the source feeding the AM1 or AM2 modulator on or off; other active modulators are not affected. See Fig. 4-1 on page 4-19.

Corresponds to the SOURCE ON/OFF key.

Parameters: <Boolean>

Valid values: OFF | ON | 0 | 1

*RST sets: ON

OUTPut:MODulation:AM[1]|2[:STATe]?

Description: Queries the state of the amplitude modulation source.

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

OUTPut:MODulation:BURst[:STATe]

Description: Turns the source feeding the burst modulator on or off; other active modulators are not affected. See Fig. 4-1 on page 4-19.

Corresponds to the SOURCE ON/OFF key.

Parameters: <Boolean>

Valid values: OFF | ON | 0 | 1

*RST sets: ON

OUTPut:MODulation:BURst[:STATe]?

Description: Queries the state of the burst modulation source.

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

OUTPut:MODulation:FM[1]|2[:STATe]

Description: Turns the source feeding the FM1 or FM2 modulator on or off; other active modulators are not affected. See Fig. 4-1 on page 4-19.

Corresponds to the SOURCE ON/OFF key.

Parameters: <Boolean>

Valid values: OFF | ON | 0 | 1

*RST sets: ON

OUTPut:MODulation:FM[1]|2[:STATe]?

Description: Queries the state of the frequency modulation source.

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

OUTPut:MODulation:IQ[:STATe]

Description: Turns the source feeding the IQ modulator on or off; other active modulators are not affected. See Fig. 4-1 on page 4-19.

Corresponds to the SOURCE ON/OFF key.

Parameters: <Boolean>

Valid values: OFF | ON | 0 | 1

*RST sets: ON

OUTPut:MODulation:IQ[:STATe]?

Description: Queries the state of the IQ modulation source.

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

OUTPut:**MOD**ulation:**PM**[1]|2[:STATe]

Description: Turns the source feeding the PM1 or PM2 modulator on or off; other active modulators are not affected. See Fig. 4-1 on page 4-19.

Corresponds to the SOURCE ON/OFF key.

Parameters: <Boolean>

Valid values: OFF | ON | 0 | 1

*RST sets: ON

OUTPut:**MOD**ulation:**PM**[1]|2[:STATe]?

Description: Queries the state of the phase modulation source.

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

OUTPut:**MOD**ulation:**PULM**[:STATe]

Description: Turns the source feeding the pulse modulator on or off; other active modulators are not affected. See Fig. 4-1 on page 4-19.

Corresponds to the SOURCE ON/OFF key.

Parameters: <Boolean>

Valid values: OFF | ON | 0 | 1

*RST sets: ON

OUTPut:**MOD**ulation:**PULM**[:STATe]?

Description: Queries the state of the pulse modulation source.

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

OUTPut:MODulation[:STATe]

Description: Enables or disables all the active modulation outputs. See Fig. 4-1 on page 4-19.

When ON, this command causes each modulation output to adopt the state set by its relevant `[SOURce][:MODulation]:<modn>:STATe` command (page 4-39 onwards).

The carrier (controlled by the `OUTPut[:POWer][:STATe]` command, page 4-24) is not affected.

Corresponds to the MOD ON/OFF key.

Parameters: <Boolean>

Valid values: OFF | ON | 0 | 1

*RST sets: ON

OUTPut:MODulation[:STATe]?

Description: Queries the state of the active modulation outputs.

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

OUTPut[:POWer]:PROTection:CLEar

Description: Resets the reverse power protection circuit.

Parameters: None

OUTPut[:POWer]:PROTection:TRIPped?

Description: Queries the state of the reverse power protection circuit: reset (0) or tripped (1).

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

OUTPut[:POWer][:STATe]

Description: Turns the RF output on or off. This is the 'final' switch before the RF OUTPUT socket, and has no effect on the configuration of modulation paths within the instrument.

Corresponds to the RF ON/OFF key.

Parameters: <Boolean>

Valid values: OFF | ON | 0 | 1

*RST sets: OFF

Example:

OUTPut[:POWer][:STATe]?

Description: Queries whether the RF output is on (1) or off (0).

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

Reference oscillator commands

(ROSCillator subsystem)

Internal/external reference frequency

Commands for:

- choosing the source of the instrument's reference oscillator
- outputting the internal reference signal.

ROSCillator
:INTernal
:ADJust
:SAVE
[:VALue]\?
:SOURce\?

ROSCillator**:INT**ernal**:ADJ**ust**:SAVE**

Description: Saves the manually-entered offset from the reference oscillator's tuning value.

Parameters: None

*RST sets: No effect

ROSCillator**:INT**ernal**:ADJ**ust[:VALue]

Description: Sets an offset from the reference oscillator's tuning value, which is established during calibration.

Parameters: <numeric_value>

Valid values: <NRf> | MAXimum | MINimum

*RST sets: No effect

ROSCillator**:INT**ernal**:ADJ**ust[:VALue]?

Description: Queries the offset from the reference oscillator's tuning value.

Parameters: None

Response: <NR2>

Returned values: Offset frequency in Hz

ROSCillator**:SOUR**ce

Description: Selects an internal or external frequency standard.

Parameters: <CPD>

Valid values: INT | EXT10DIR | EXT1IND | EXT10IND | INT10OUT

Internal | External 10 MHz direct | External 1 MHz indirect | External 10 MHz indirect | Internal 10 MHz out

Internal: the instrument's own internal 10 MHz standard.

External: a 1 or 10 MHz external standard.

Direct: the internal standard for the instrument's RF section is provided directly from the external standard.

Indirect: the internal standard is provided from the OCXO, locked to the external standard.

*RST sets: No effect

ROSCillator**:SOUR**ce?

Description: Queries which frequency standard is selected.

Parameters: None

Response: <CRD>

Returned values: INT | EXT10DIR | EXT1IND | EXT10IND | INT10OUT

The [SOURce] subsystem — an introduction

The SOURce subsystem contains commands that cover all aspects of frequency, modulation, power and sweeping

The [SOURce] subsystem consists of:

- The [FREQuency] subsystem, which controls frequency parameters of the carrier and sweep signals
- The [MODulation]:AM subsystem, which controls all aspects of AM modulation
- The [MODulation]:ARB subsystem, which controls all aspects of ARB modulation
- The [MODulation]:FM subsystem, which controls all aspects of FM modulation
- The [MODulation]:PM subsystem, which controls all aspects of pulse modulation
- The [MODulation]:PULM subsystem, which turns pulse modulation on or off
- The [POWer] subsystem, which sets all aspects of carrier and sweep levels
- The [SWEep] subsystem, which controls the generation of sweep signals.

Each of these subsystems is dealt with separately in the following sections.

The [SOURce] subsystem effectively controls the switching and configuration of internal and external signal sources and modulation paths within the instrument. Fig. 4-1 on page 4-19 is a representation of the `OUTput` and `[SOURce]` commands and their relationship to the sources.

You can see from this that the `[SOURce]` commands control:

the configuration of signal sources:

```
[SOURce][:MODulation]:<modn>:EXTernal
[SOURce][:MODulation]:<modn>:INTernal;
```

the selection of signal sources:

```
[SOURce][:MODulation]:<modn>:SOURce;
```

as well as switching the modulation paths on and off:

```
[SOURce][:MODulation]:<modn>:STATe.
```

Note that Fig. 4-1 does not necessarily represent the actual hardware in the instrument.

The menu structure of the [SOURce] subsystem is as follows:

[SOURce]	
:FREQuency	Carrier frequency
[:MODulation]	Carrier modulation...
:AM[1]|2	...AM
:FM[1]|2	...FM
:IQ	...IQ
:PM[1]|2	...phase
:PULM	...pulse
:POWer	RF level
:SWEep	Carrier sweep

RF output frequency commands

([SOURce]:FREQuency subsystem)

Carrier frequency, phase, sweep

Commands for:

- Setting carrier frequency, phase and phase reference
- Setting carrier frequency mode
- Setting carrier frequency step size
- Setting carrier sweep mode operating frequency
- Setting carrier sweep step size, spacing and mode
- Setting carrier sweep stop and start frequencies.

```
[SOURce]
    :FREQuency
        [:CW|:FIXed]\?
            :STEP
                [:INCRement]\?
        :MODE\?
        :PHASe
            [:ADJust]\?
            REFerence\?
        :SWEep
            :DWELl\?
            :MANual
            :SPACing\?
            :STARt\?
            :STEP
                [:LINear]\?
                :LOGarithmic\?
            :STOP\?
```

[SOURce]:FREQuency[:CW|:FIXed]

Description: Sets the carrier frequency by value, to maximum or minimum, stepping up or down, returning to the last full setting, or setting the current value to be the new setting.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum | UP | DOWN | RETurn | REFerence

*RST sets: MAX

[SOURce]:FREQuency[:CW|:FIXed]?

Description: Queries the carrier frequency by value.

Parameters: None

Response: <NR2>

Returned values: Carrier frequency in Hz

[SOURce]:FREQuency[:CW|:FIXed]:STEP[:INCRement]

Description: Sets the carrier frequency step size.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum

*RST sets: 1 kHz

[SOURce]:FREQuency[:CW|:FIXed]:STEP[:INCRement]?

Description: Queries the carrier frequency step size by value.

Parameters: None

Response: <NR2>

Returned values: Carrier frequency step size in Hz

[SOURce]:FREQuency:MODE

Description: Sets the mode of operation of the carrier frequency.

Parameters: <CPD>

Valid values: CW | FIXed | SWEep

`CW` *and* `FIXed` *are aliases; both are implemented here, as required by SCPI.*

*RST sets: CW

[SOURce]:FREQuency:MODE?

Description: Queries the mode of operation of the carrier frequency.

Parameters: None

Response: <CRD>

Returned values: CW | FIX | SWE

[SOURce]:FREQuency:PHASe[:ADJust]

Description: Sets the carrier frequency phase.

Parameters: <NRf>

Valid values: -360° to 0° to +360°

*RST sets: 0°

[SOURce]:FREQuency:PHASe[:ADJust]?

Description: Queries the carrier frequency phase.

Parameters: None

Response: <NR2>

Returned values: Degrees

[SOURce]:FREQuency:PHASe:REFerence

Description: Sets the current carrier frequency phase as a zero reference.

Parameters: None

[SOURce]:FREQuency:PHASe:REFerence?

Description: Queries the carrier frequency's phase relative to the zero reference.

Parameters: None

Response: <NR2>

Returned values: Degrees

[SOURce]:FREQuency:SWEep:DWELl

Description: Sets the time per sweep step for the carrier frequency.

Parameters: <NRf>

*RST sets: 50 ms

[SOURce]:FREQuency:SWEep:DWELl?

Description: Queries the time per sweep step for the carrier frequency.

Parameters: None

Response: <NR2>

Returned values: Time in ms.

[SOURce]:**FREQ**uency:**SWE**ep:**MAN**ual

Description: Sets a new carrier frequency whilst a sweep is paused.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum | UP | DOWN

Set by value, to maximum or minimum, or stepping up or down.

This command is available only when `FREQ:MODE SWEep` is selected, and sweep operation is not in progress (PAUSED or WAITING FOR TRIGGER). The frequency value should be limited to the range determined by `FREQ:SWEep:STARt` and `FREQ:SWEep:STOP`.

[SOURce]:**FREQ**uency:**SWE**ep:**MAN**ual?

Description: Queries the carrier frequency set during a paused sweep.

Parameters: None

Response: <NR2>

Returned values: Carrier frequency in Hz

[SOURce]:**FREQ**uency:**SWE**ep:**SPAC**ing

Description: Sets the carrier sweep step points to either linear or logarithmic spacing.

Parameters: <CPD>

Valid values: LINear | LOGarithmic

*RST sets: LIN

[SOURce]:**FREQ**uency:**SWE**ep:**SPAC**ing?

Description: Queries whether carrier sweep step points have linear or logarithmic spacing.

Parameters: None

Response: <CRD>

Returned values: LIN | LOG

[SOURce]:FREQuency:SWEep:STARt

Description: Sets the start frequency for a carrier sweep.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum

*RST sets: MIN

[SOURce]:FREQuency:SWEep:STARt?

Description: Queries the start frequency for a carrier sweep.

Parameters: None

Response: <NR2>

Returned values: Start frequency in Hz

[SOURce]:FREQuency:SWEep:STEP[:LINear]

Description: Sets the size of linear carrier sweep steps.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum

*RST sets: 1 kHz

[SOURce]:FREQuency:SWEep:STEP[:LINear]?

Description: Queries the size of linear carrier sweep steps.

Parameters: None

Response: <NR2>

Returned values: Sweep step size in Hz

[SOURce]:FREQuency:SWEep:STEP:LOGarithmic

Description: Sets the size of logarithmic carrier sweep steps.

Parameters: <numeric_value>

Valid values: <NRf>(PCT) | MAXimum | MINimum

*RST sets: 1 PCT

[SOURce]:FREQuency:SWEep:STEP[:LOGarithmic]?

Description: Queries the size of logarithmic carrier sweep steps.

Parameters: None

Response: <NR2>

Returned values: Sweep step size as a percentage

[SOURce]:FREQuency:SWEep:STOP

Description: Sets the stop frequency for the carrier sweep.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum

*RST sets: MAX

[SOURce]:FREQuency:SWEep:STOP?

Description: Queries the carrier sweep's stop frequency.

Parameters: None

Response: <NR2>

Returned values: Sweep stop frequency in Hz

AM commands

([SOURce][:MODulation]:AM subsystem)

AM depth, source, frequency, waveshape, mod. sweep, phase, input parameters

Commands for:

- Setting AM frequency and frequency step size
- Setting AM depth and depth step size
- Setting AM coupling, impedance and sensitivity
- Setting AM mode (fixed or sweep)
- Setting AM waveshape and time per sweep
- Setting AM sweep parameters
- Setting internal/external source on/off
- Setting phase relationship of AM2 with respect to AM1.

```
[SOURce]
    [:MODulation]
        :AM[1]|2
            [:DEPTh]\?
                :STEP
                    [:INCRement]\?
            :EXTernal
                :COUPling\?
                :IMPedance\?
                :SENSitivity\?
            :INTernal
                :FREQuency\?
                    [:FIXed]
                        :STEP
                            [:INCRement]\?
                    :MODE\?
                    :SWEep
                        :DWELl\?
                        :MANual\?
                        :SPACing\?
                        :STARt\?
                        :STEP
                            [:LINear]\?
                            :LOGarithmic\?
                        :STOP\?
                :SHAPe\?
            :SOURce\?
            :STATe\?
        :AM2
            :INTernal
                :PHASe\?
                    :SENSitivity\?
```

[SOURce][:MODulation]**:AM**[1]|2[:DEPTh]

Description: Sets the AM depth as a percentage.

Parameters: <numeric_value>

Valid values: <NRf>(PCT) | MAXimum | MINimum | UP | DOWN | RETurn | REFerence

Set by value, to maximum or minimum, stepping up or down, returning to the last full setting, or setting the current value to the last full setting.

*RST sets: MIN

[SOURce][:MODulation]**:AM**[1]|2[:DEPTh]?

Description: Queries the AM depth.

Parameters: None

Response: <NR2>

Returned values: AM depth as a percentage

[SOURce][:MODulation]**:AM**[1]|2[:DEPTh]**:STEP**[:INCRement]

Description: Sets the AM depth step size as a percentage.

Parameters: <numeric_value>

Valid values: <NRf>(PCT) | MAXimum | MINimum

*RST sets: 1 PCT

[SOURce][:MODulation]**:AM**[1]|2[:DEPTh]**:STEP**[:INCRement]?

Description: Queries the AM depth step size.

Parameters: None

Response: <NR2>

Returned values: AM depth step size as a percentage

[SOURce][:MODulation]**:AM**[1]|2**:EXT**ernal**:COUP**ling

Description: Selects AC or DC coupling for the external source.

Parameters: <CPD>

Valid values: AC | DC

*RST sets: AC

[SOURce][:MODulation]**:AM**[1]|2**:EXT**ernal**:COUP**ling?

Description: Queries whether the external source is AC- or DC-coupled.

Parameters: None

Response: <CRD>

Returned values: AC | DC

[SOURce][:MODulation]**:AM**[1]|2**:EXT**ernal**:IMP**edance

Description: Selects the impedance of the external source input — 50 Ω or 100 kΩ.

Parameters: <CPD>

Valid values: Z50 | K100

*RST sets: Z50 (in SCPI mode) or K100 (in 202x emulation).

[SOURce][:MODulation]**:AM**[1]|2**:EXT**ernal**:IMP**edance?

Description: Queries the impedance of the external source input.

Parameters: None

Response: <CRD>

Returned values: Z50 | K100

[SOURce][:MODulation]**:AM**[1]|2**:EXT**ernal**:SENS**itivity

Description: Selects the sensitivity of the external source input for AM — 1 V RMS or 1 V peak.

Parameters: <CPD>

Valid values: VRMS | VPK

*RST sets: VRMS

[SOURce][:MODulation]**:AM**[1]|2**:EXT**ernal**:SENS**itivity?

Description: Queries the sensitivity of the external source input for AM.

Parameters: None

Response: <CRD>

Returned values: VRMS | VPK

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency[:FIXed]

Description: Sets the internal AM frequency.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum | UP | DOWN | RETurn | REFerence

Set by value, to maximum or minimum, stepping up or down, returning to the last full setting, or setting the current value to the last full setting.

*RST sets: AM1 = 1 kHz, AM2 = 400 Hz

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency[:FIXed]?

Description: Queries the internal AM frequency.

Parameters: None

Response: <NR2>

Returned values: AM frequency in Hz

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency[:FIXed] **:STEP**[:INCRement]

Description: Sets the internal AM frequency step.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum

*RST sets: 10 Hz

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency[:FIXed] **:STEP**[:INCRement]?

Description: Queries the internal AM frequency step size.

Parameters: None

Response: <NR2>

Returned values: AM frequency step size in Hz

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency**:MODE**

Description: Sets the mode of the AM frequency operation.

Parameters: <CPD>

Valid values: FIXed | SWEep

*RST sets: FIXed

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency**:MODE**?

Description: Queries the mode of the AM frequency operation (fixed or sweep).

Parameters: None

Response: <CRD>

Returned values: FIX | SWE

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:DWEL**l

Description: Sets the time per sweep step for AM.

Parameters: <numeric_value>

Valid values: <NRf>(ms) | MAXimum | MINimum

*RST sets: 50 ms

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:DWEL**l?

Description: Queries the time per sweep step for AM.

Parameters: None

Response: <NR2>

Returned values: Dwell time in ms

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:MAN**ual

Description: Sets a new AM frequency whilst a sweep is paused.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum | UP | DOWN

Set by value, to maximum or minimum, or stepping up or down.

This command is available only when `AM[1]|2:INTernal:MODE SWEep` is selected, and sweep operation is not in progress (PAUSED or WAITING FOR TRIGGER). The frequency value should be limited to the range determined by `AM[1]|2:INTernal:SWEep:STARt` and `AM[1]|2:INTernal:SWEep:STOP`.

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:MAN**ual?

Description: Queries the AM frequency set during a paused sweep.

Parameters: None

Response: <NR2>

Returned values: AM frequency in Hz

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:SPAC**ing

Description: Sets the mode of sweep spacing for AM.

Parameters: <CPD>

Valid values: LINear | LOGarithmic

*RST sets: LIN

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:SPAC**ing?

Description: Queries the mode of sweep spacing for AM.

Parameters: None

Response: <CRD>

Returned values: LIN | LOG

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STAR**t

Description: Sets the start frequency for the AM sweep.

Parameters: <numeric_value>

Valid values: <freq>(Hz) | MAXimum | MINimum

*RST sets: MIN

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STAR**t?

Description: Queries the start frequency for the AM sweep.

Parameters: None

Response: <NR2>

Returned values: AM sweep start frequency in Hz

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STEP**[:LINear]

Description: Sets the size of the step for linear AM sweeps.

Parameters: <numeric_value>

Valid values: <freq>(Hz) | MAXimum | MINimum

*RST sets: 1 kHz

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STEP**[:LINear]?

Description: Queries the size of the step for linear AM sweeps.

Parameters: None

Response: <NR2>

Returned values: Linear sweep step size in Hz

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STEP:LOG**arithmic

Description: Sets the size of the step for logarithmic AM sweeps as a percentage.

Parameters: <numeric_value>

Valid values: <NRf>(PCT) | MAXimum | MINimum

*RST sets: 1 PCT

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STEP:LOG**arithmic?

Description: Queries the size of the step for logarithmic AM sweeps.

Parameters: None

Response: <NR2>

Returned values: Logarithmic sweep step size as a percentage

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STOP**

Description: Sets the stop frequency for the AM sweep.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum

*RST sets: MAX

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STOP**?

Description: Queries the stop frequency for the AM sweep.

Parameters: None

Response: <NR2>

Returned values: AM sweep stop frequency in Hz

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:SHAP**e

Description: Selects the shape of the internally-generated AM waveform.

Parameters: <CPD>

Valid values: SINE | SQUare | TRIangle | RAMP

*RST sets: SINE

[SOURce][:MODulation]**:AM**[1]|2**:INT**ernal**:SHAP**e?

Description: Queries the shape of the internally generated AM.

Parameters: None

Response: <CRD>

Returned values: SINE | SQU | TRI | RAMP

[SOURce][:MODulation]:AM[1]|2:SOURce

Description: Selects either an internal or external source to generate AM.

Parameters: <CPD>

Valid values: INTernal | EXTernal

*RST sets: INT

[SOURce][:MODulation]:AM[1]|2:SOURce?

Description: Queries whether the source for AM is internal or external.

Parameters: None

Response: <CRD>

Returned values: INT | EXT

[SOURce][:MODulation]:AM[1]|2:STATe

Description: Adds AM1 or AM2 to the set of active modulations, or removes AM1 or AM2 from it: see Fig. 4-1 on page 4-19.

Parameters: <Boolean>

Valid values: OFF | ON | 0 | 1

*RST sets: OFF

[SOURce][:MODulation]:AM[1]|2:STATe?

Description: Queries whether the AM path is on (1) or off (0).

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

[SOURce][:MODulation]**:AM2:INT**ernal**:PHAS**e

Description: Sets the phase offset of AM2 relative to AM1.

Parameters: <numeric_value>

Valid values: <NRf> | UP | DOWN

*RST sets: 0

[SOURce][:MODulation]**:AM2:INT**ernal**:PHAS**e?

Description: Queries the phase offset of AM2 relative to AM1.

Parameters: None

Response: <NR2>

Returned values: Phase angle (degrees)

[SOURce][:MODulation]**:AM2:INT**ernal**:PHAS**e**:SENS**itivity

Description: Selects the sensitivity of the rotary control or (×10 ⇩) and (÷10 ⇧) keys when setting up the phase offset of AM2 relative to AM1.

Parameters: <CPD>

Valid values: FINe (0.01º resolution)
MEDium (0.1º resolution)
COARse (1.0º resolution)

*RST sets: FINe

[SOURce][:MODulation]**:AM2:INT**ernal**:PHAS**e**:SENS**itivity?

Description: Queries the sensitivity of the rotary control or (×10 ⇩) and (÷10 ⇧) keys when setting up the phase offset of AM2 relative to AM1.

Parameters: None

Response: <CRD>

Returned values: FIN | MED | COAR

Burst commands

([SOURce][:MODulation]:BURst subsystem)

Burst source, rise and fall times, attenuation, position

Commands for:

- Setting burst control parameters.

[SOURce]
[:MODulation]
:BURSt

:ALTernate	Set burst...
:ATTenuation\?	...attenuation
:SOURce\?	...source
:DDELta\?	...'on' time
:FTIMe\?	...fall time
:OFFSet\?	...positioning
:RTIMe\?	...rise time
:SOURce\?	
:STATe\?	
:TINTerval\?	...trigger interval

[SOURce][:MODulation]**:BURS**t**:ALT**ernate**:ATT**enuation

Description: Sets attenuation to decrease the RF level from the nominal value.

Parameters: <numeric_value>

Valid values: <NRf>(dB) | MAXimum | MINimum

*RST sets: MINimum

[SOURce][:MODulation]**:BURS**t**:ALT**ernate**:ATT**enuation?

Description: Queries the attenuation setting.

Parameters: None

Response: <NR2>

Returned values: Level in dB

[SOURce][:MODulation]**:BURS**t**:ALT**ernate**:SOUR**ce

Description: Selects the source for the attenuation control bit.

Parameters: <CPD>

Valid values: EXTernal | INTernal

EXT is the rear-panel AUX IN/OUT connector.
INT is the marker 2 attenuation control bit from the ARB.

*RST sets: EXTernal

[SOURce][:MODulation]**:BURS**t**:ALT**ernate**:SOUR**ce?

Description: Queries the source for the attenuation control bit.

Parameters: None

Response: <CRD>

Returned values: EXT | INT

[SOURce][:MODulation]**:BURS**t**:DDEL**ta

Description: Sets the burst duration delta, which modifies the burst length ('on' time).

Parameters: <numeric_value>

Valid values: <NRf>(s) | MAXimum | MINimum

*RST sets: 0.0µs

[SOURce][:MODulation]**:BURS**t**:FTIM**e

Description: Sets the burst fall time

Parameters: <numeric_value>

Valid values: <NRf>(s) | MAXimum | MINimum

*RST sets: MINimum

[SOURce][:MODulation]**:BURS**t**:FTIM**e?

Description: Queries the burst fall time.

Parameters: None

Response: <NR2>

Returned values: Time in seconds.

[SOURce][:MODulation]**:BURS**t**:OFFS**et

Description: Sets the burst offset, which positions the burst with respect to the marker 1 or external trigger input.

Parameters: <numeric_value>

Valid values: <NRf>(s) | MAXimum | MINimum

*RST sets: 0.0µs

[SOURce][:MODulation]**:BURS**t**:RTIM**e

Description: Sets the burst rise time.

Parameters: <numeric_value>

Valid values: <NRf>(s) | MAXimum | MINimum

*RST sets: MINimum

[SOURce][:MODulation]**:BURS**t**:RTIM**e?

Description: Queries the burst rise time.

Parameters: None

Response: <NR2>

Returned values: Time in seconds.

[SOURce][:MODulation]:BURSt:SOURce

Description: Selects the source for burst control.

Parameters: <CPD>

Valid values: EXTernal | INTernal

EXT is the rear-panel BURST GATE IN connector.
INT is the marker 1 control bit from the ARB.

*RST sets: EXTernal

[SOURce][:MODulation]:BURSt:SOURce?

Description: Queries the source for burst control.

Parameters: None

Response: <CRD>

Returned values: EXT | INT

[SOURce][:MODulation]:BURSt:STATe

Description: Adds Burst to the set of active modulations, or removes Burst from it: see Fig. 4-1 on page 4-19.

Parameters: <Boolean>

Valid values: OFF | ON | 0 | 1

*RST sets: OFF

[SOURce][:MODulation]:BURSt:STATe?

Description: Queries whether the Burst path is on (1) or off (0).

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

[SOURce][:MODulation]:BURSt:TINTerval

Description: Sets the burst trigger interval, the time taken for the output power to settle at the user-defined level after the marker 1/external trigger input.

Parameters: <numeric_value>

Valid values: <NRf>(s) | MAXimum | MINimum

*RST sets: 1.5 x rise time, minimum

FM commands

([SOURce][:MODulation]:FM subsystem)

FM deviation, source, frequency, waveshape, mod. sweep, phase, input parameters, DC null

Commands for:

- Setting FM frequency and frequency step size
- Setting FM depth and depth step size
- Setting FM coupling, impedance and sensitivity
- Setting DC null
- Setting FM mode (fixed or sweep)
- Setting FM waveshape and time per sweep
- Setting FM sweep parameters
- Setting internal/external source on/off
- Setting phase relationship of FM2 with respect to FM1.

```
[SOURce]
    [:MODulation]
        :FM[1]|2
            [:DEViation]\?
                :STEP
                    [:INCRement]\?
            :EXTernal
                :COUPling\?
                :DNULl
                :IMPedance\?
                :SENSitivity\?
            :INTernal
                :FREQuency\?
                    [:FIXed]
                        :STEP
                            [:INCRement]\?
                    :MODE\?
                    :SWEep
                        :DWELl\?
                        :MANual\?
                        :SPACing\?
                        :STARt\?
                        :STEP
                            [:LINear]\?
                            :LOGarithmic\?
                        :STOP\?
                :SHAPe\?
            :SOURce\?
            :STATe\?
        :FM2
            :INTernal
                :PHASe\?
                    :SENSitivity\?
```

[SOURce][:MODulation]**:FM**[1]|2[:DEViation]

Description: Sets the FM deviation.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum | UP | DOWN | RETurn | REFerence

Set by value, to maximum or minimum, stepping up or down, returning to the last full setting, or setting the current value to the last full setting.

*RST sets: MIN

[SOURce][:MODulation]**:FM**[1]|2[:DEViation]?

Description: Queries the FM deviation.

Parameters: None

Response: <NR2>

Returned values: FM deviation in Hz

[SOURce][:MODulation]**:FM**[1]|2[:DEViation]**:STEP**[:INCRement]

Description: Sets the FM deviation step size.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum

*RST sets: 1 kHz

[SOURce][:MODulation]**:FM**[1]|2[:DEViation]**:STEP**[:INCRement]?

Description: Queries the FM deviation step size.

Parameters: None

Response: <NR2>

Returned values: FM deviation step size in Hz

[SOURce][:MODulation]**:FM**[1]|2**:EXT**ernal**:COUP**ling

Description: Selects AC or DC coupling for the external source.

Parameters: <CPD>

Valid values: AC | DC

*RST sets: AC

[SOURce][:MODulation]**:FM**[1]|2**:EXT**ernal**:COUP**ling?

Description: Queries whether the external source is AC- or DC-coupled.

Parameters: None

Response: <CRD>

Returned values: AC | DC

[SOURce][:MODulation]**:FM**[1]|2**:EXT**ernal:**DNUL**l

Description: Performs a DC FM null.

Reminder: you need to apply a ground reference to the external modulation input.

Parameters: None

[SOURce][:MODulation]**:FM**[1]|2**:EXT**ernal**:IMP**edance

Description: Selects the impedance of the external source input — 50 Ω or 100 kΩ.

Parameters: <CPD>

Valid values: Z50 | K100

*RST sets: Z50 (in SCPI mode) or K100 (in 202x emulation).

[SOURce][:MODulation]**:FM**[1]|2**:EXT**ernal**:IMP**edance?

Description: Queries the impedance of the external source input.

Parameters: None

Response: <CRD>

Returned values: Z50 | K100

[SOURce][:MODulation]**:FM**[1]|2**:EXT**ernal**:SENS**itivity

Description: Selects the sensitivity of the external source input for FM — 1 V RMS or 1 V peak.

Parameters: <CPD>

Valid values: VRMS | VPK

*RST sets: VRMS

[SOURce][:MODulation]**:FM**[1]|2**:EXT**ernal**:SENS**itivity?

Description: Queries the sensitivity of the external source input for FM.

Parameters: None

Response: <CRD>

Returned values: VRMS | VPK

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency[:FIXed]

Description: Sets the internal FM frequency.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum | UP | DOWN | RETurn | REFerence

Set by value, to maximum or minimum, stepping up or down, returning to the last full setting, or setting the current value to the last full setting.

*RST sets: FM1 = 1 kHz, FM2 = 400 Hz

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency[:FIXed]?

Description: Queries the internal FM frequency.

Parameters: None

Response: <NR2>

Returned values: FM frequency in Hz

[SOURce][:MODulation]FM[1]|2**:INT**ernal**:FREQ**uency[:FIXed] **:STEP**[:INCRement]

Description: Sets the internal FM frequency step.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum

*RST sets: 10 Hz

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency[:FIXed] **:STEP**[:INCRement]?

Description: Queries the internal FM frequency step size.

Parameters: None

Response: <NR2>

Returned values: FM frequency step size in Hz

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency**:MODE**

Description: Sets the mode of the FM frequency operation.

Parameters: <CPD>

Valid values: FIXed | SWEep

*RST sets: FIXed

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency**:MODE**?

Description: Queries the mode of the FM frequency operation (fixed or sweep).

Parameters: None

Response: <CRD>

Returned values: FIX | SWE

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:DWEL**l

Description: Sets the time per sweep step for FM.

Parameters: <numeric_value>

Valid values: <NRf>(ms) | MAXimum | MINimum

*RST sets: 50 ms

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:DWEL**l?

Description: Queries the time per sweep step for FM.

Parameters: None

Response: <NR2>

Returned values: Dwell time in ms

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:MAN**ual

Description: Sets a new FM frequency whilst a sweep is paused.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum | UP | DOWN

Set by value, to maximum or minimum, or stepping up or down.

This command is available only when `FM[1]|2:INTernal:MODE SWEep` is selected, and sweep operation is not in progress (PAUSED or WAITING FOR TRIGGER). The frequency value should be limited to the range determined by `FM[1]|2:INTernal:SWEep:STARt` and `FM[1]|2:INTernal:SWEep:STOP`.

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:MAN**ual?

Description: Queries the FM frequency set during a paused sweep.

Parameters: None

Response: <NR2>

Returned values: AM frequency in Hz

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:SPAC**ing

Description: Sets the mode of sweep spacing for FM.

Parameters: <CPD>

Valid values: LINear | LOGarithmic

*RST sets: LIN

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:SPAC**ing?

Description: Queries the mode of sweep spacing for FM.

Parameters: None

Response: <CRD>

Returned values: LIN | LOG

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STAR**t

Description: Sets the start frequency for the FM sweep.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum

*RST sets: MIN

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STAR**t?

Description: Queries the start frequency for the FM sweep.

Parameters: None

Response: <NR2>

Returned values: AM sweep start frequency in Hz

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STEP**[:LINear]

Description: Sets the size of the step for linear FM sweeps.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum

*RST sets: 1 kHz

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STEP**[:LINear]?

Description: Queries the size of the step for linear FM sweeps.

Parameters: None

Response: <NR2>

Returned values: Linear sweep step size in Hz

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STEP:LOG**arithmic

Description: Sets the size of the step for logarithmic FM sweeps as a percentage.

Parameters: <numeric_value>

Valid values: <NRf>(PCT) | MAXimum | MINimum

*RST sets: 1 PCT

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STEP:LOG**arithmic?

Description: Queries the size of the step for logarithmic FM sweeps.

Parameters: None

Response: <NR2>

Returned values: Logarithmic sweep step size as a percentage

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STOP**

Description: Sets the stop frequency for the FM sweep.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum

*RST sets: MAX

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STOP**?

Description: Queries the stop frequency for the FM sweep.

Parameters: None

Response: <NR2>

Returned values: FM sweep stop frequency in Hz

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:SHAP**e

Description: Selects the shape of the internally generated FM.

Parameters: <CPD>

Valid values: SINE | SQUare | TRIangle | RAMP

*RST sets: SINE

[SOURce][:MODulation]**:FM**[1]|2**:INT**ernal**:SHAP**e?

Description: Queries the shape of the internally generated FM.

Parameters: None

Response: <CRD>

Returned values: SINE | SQU | TRI | RAMP

[SOURce][:MODulation]:FM[1]|2:SOURce

Description: Selects either an internal or external source to generate FM.

Parameters: <CPD>

Valid values: INTernal | EXTernal

*RST sets: INT

[SOURce][:MODulation]:FM[1]|2:SOURce?

Description: Queries whether the source for FM is internal or external.

Parameters: None

Response: <CRD>

Returned values: INT | EXT

[SOURce][:MODulation]:FM[1]|2:STATe

Description: Adds FM1 or FM2 to the set of active modulations, or removes FM1 or FM2 from it: see Fig. 4-1 on page 4-19.

Parameters: <Boolean>

Valid values: OFF | ON | 0 | 1

*RST sets: OFF

[SOURce][:MODulation]:FM[1]|2:STATe?

Description: Queries whether the FM path is on (1) or off (0).

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

[SOURce][:MODulation]**:FM2:INT**ernal**:PHAS**e

Description: Sets the phase offset of FM2 relative to FM1.

Parameters: <numeric_value>

Valid values: <NRf> | UP | DOWN

*RST sets: 0

[SOURce][:MODulation]**:FM2:INT**ernal**:PHAS**e?

Description: Queries the phase offset of FM2 relative to FM1.

Parameters: None

Response: <NR2>

Returned values: Phase angle (degrees)

[SOURce][:MODulation]**:FM2:INT**ernal**:PHAS**e**:SENS**itivity

Description: Selects the sensitivity of the rotary control or (x10 ⇩) and (÷10 ⇧) keys when setting up the phase offset of FM2 relative to FM1.

Parameters: <CPD>

Valid values: FINe (0.01º resolution)
MEDium (0.1º resolution)
COARse (1.0º resolution)

*RST sets: FINe

[SOURce][:MODulation]**:FM2:INT**ernal**:PHAS**e**:SENS**itivity?

Description: Queries the sensitivity of the rotary control or (x10 ⇩) and (÷10 ⇧) keys when setting up the phase offset of FM2 relative to FM1.

Parameters: None

Response: <CRD>

Returned values: FIN | MED | COAR

IQ commands

([SOURce][:MODulation]:IQ subsystem)

IQ source parameters, ARB handling, triggering

Commands for:

- Setting external source impedance
- Controlling ARB generation
- Setting ARB parameters
- Manipulating ARB files
- Setting IQ internal/external source on/off
- Setting trigger mode.

[SOURce][:MODulation]
:IQ
:ARB
:ABORt
:FORMat\?
:INITiate
:MODE\?
:TOFFset\? ARB tuning offset
:TRIGger\?
:WAVeform
:BURSt
:PRESet
:CATalog?
:CHECksum?
:DATA
:DELete
:ALL
[:FILE]
:HEADer?
:SELect\?
:SUMMary?
:EXTernal
:IMPedance\?
:SOURce\?
:STATe\?

[SOURce][:MODulation]**:IQ:ARB:ABOR**t

Description: Stops ARB generation.

Parameters: None

[SOURce][:MODulation]**:IQ:ARB:FORM**at

Description: Formats the ARB memory with the requested number of wide sectors reserved as narrow sectors. Each reserved wide sector will give three narrow ones.

Parameters: <numeric_value>

Valid values: <NRf> | MAXimum | MINimum

[SOURce][:MODulation]**:IQ:ARB:FORM**at?

Description: Returns the ARB memory's formatting information.

Parameters: None

Response: <NR1>,<NR1>,<NR1>

Returned values: Memory size in wide sectors, number of formatted narrow sectors, number of formatted wide sectors.

[SOURce][:MODulation]**:IQ:ARB:INIT**iate

Description: Starts ARB generation.

Parameters: None

[SOURce][:MODulation]**:IQ:ARB:MODE**

Description: Controls ARB generation. CONTinuous generates the selected waveform continuously. A SINGle command generates one cycle of the selected waveform.

Parameters: <CPD>

Valid values: SINGle | CONTinuous

*RST sets CONT

[SOURce][:MODulation]**:IQ:ARB:MODE**?

Description: Returns the ARB generation mode.

Parameters: None

Response: <CRD>

Returned values: SING | CONT

[SOURce][:MODulation]**:IQ:ARB:ROFF**set

Description: Adjusts the RMS offset level of the ARB waveform.

Parameters: <numeric_value>

Valid values: <NRf> | MAXimum | MINimum

*RST sets 0 dB

Example:

[SOURce][:MODulation]**:IQ:ARB:ROFF**set?

Description: Returns the modulation level's RMS offset.

Parameters: None

Response: <NR2>

Returned values: Modulation RMS offset value in dB

Example:

[SOURce][:MODulation]**:IQ:ARB:TOFF**set

Description: Adjusts the sample clock's tuning offset in parts per million.

Parameters: <numeric_value>

Valid values: <NRf> | MAXimum | MINimum

*RST sets 0

[SOURce][:MODulation]**:IQ:ARB:TOFF**set?

Description: Returns the sample clock's tuning offset.

Parameters: None

Response: <NR2>

Returned values: Tuning offset in parts per million

[SOURce][:MODulation]:IQ:ARB:TRIGger

Description: Sets the trigger mode to immediate; start; start then stop.

Parameters: <CPD>

Valid values: IMMediate | STARt | SSTOP

*RST sets IMM

[SOURce][:MODulation]:IQ:ARB:TRIGger?

Description: Returns the trigger mode.

Parameters: None

Response: <CRD>

Returned values: IMM | STAR | SSTOP

[SOURce][:MODulation]:IQ:ARB:WAVeform:BURSt:PRESet

Description: Sets the burst parameters to the default values for the currently selected waveform. If no waveform is selected, the instrument defaults are loaded.

Parameters: None

[SOURce][:MODulation]:IQ:ARB:WAVeform:CATalog?

Description: Returns memory available and a list of files.

Parameters: None

Response: <numeric_value>,<numeric_value>,<numeric_value>{,<string>}

<Free narrow sectors>,<Free wide sectors>,<Memory available>,{File list}

The string for each file is <name> (in character data)

Returned values: Free narrow sectors: the number of sectors (and therefore the number of low sample-rate files) that can be stored.

Free wide sectors: the space left for larger high sample-rate files.

Memory available: number of samples that can be stored in the largest contiguous block.

File list: list of file names, separated by commas.

Example:
```
:ARB:WAV:CAT? 5111808,"is95_1.aiq","is95_2.aiq"
```

[SOURce][:MODulation]**:IQ:ARB:WAV**eform**:CHEC**ksum?

Description: Returns information on whether the checksum on the file has verified or not.

Parameters: <CPD>
<name>

Response: <NR1>

Returned values: 1 checksum has verified correctly
0 checksum failure.

Example: `:ARB:WAV:CHEC? "is95.aiq" 1`

[SOURce][:MODulation]**:IQ:ARB:WAV**eform**:DATA**

Description: Copies data in block format to the ARB memory, with name.

Parameters: <CPD>,<arbitrary block program data>
<name>,<data>

Valid values: ARB filename, 40 characters max; block of packaged data

Example: `:ARB:WAV:DAT "is95.aiq",#3848<848 8-bit blocks of data>`
Note: *large amounts of ARB data may need to be sent in blocks.*
For example, using a National Instruments GPIB board:
SendSetup sets the 341x to receive data
SendDataBytes with Nullend sends data in blocks
Final block: SendDataBytes with Nlend asserts EOI.

[SOURce][:MODulation]**:IQ:ARB:WAV**eform**:DEL**ete**:ALL**

Description: Deletes all the user files in the ARB, without removing calibration files.

Parameters: None

[SOURce][:MODulation]**:IQ:ARB:WAV**eform**:DEL**ete[:FILe]

Description: Deletes the named file.

Parameters: <CPD>

Valid values: ARB filename (40 characters max.)

Example: `:ARB:WAV:DEL "is95.aiq"`

[SOURce][:MODulation]**:IQ:ARB:WAV**eform**:HEAD**er?

Description: Returns the file header in ASCII format, with lines separated by carriage return/line feed. Can consist of up to 1000 characters.

Parameters: <CPD>
<name>

Response: <CRD>

Returned values: File header text

Example: `:ARB:WAV:HEAD? "is95.aiq"`

[SOURce][:MODulation]**:IQ:ARB:WAV**eform**:SEL**ect

Description: Selects the named file to generate the waveform and starts ARB generation in single or continuous mode, according to the MODe selected.

Parameters: <CPD>

Valid values: ARB filename (40 characters max.)

Example: `:ARB:WAV:SEL "is95.aiq"`

[SOURce][:MODulation]**:IQ:ARB:WAV**eform**:SEL**ect?

Description: Returns the name of the selected ARB file.

Parameters: None

Response: <CPD>

Returned values: ARB filename (40 chars max.)

Example: `:ARB:WAV:SEL? "is95.aiq"`

[SOURce][:MODulation]**:IQ:ARB:WAV**eform**:SUMM**ary?

Description: Returns the number of samples and the IQ sample rate of the selected ARB file.

Parameters: <CPD>
<name>

Response: <NR1>,<NR1>

Returned values: Number of samples, sample rate.

Example: `:ARB:WAV:SUMM? "is95.aiq" 12800,12400000`

[SOURce][:MODulation]**:IQ:EXT**ernal**:IMP**edance

Description: Selects the impedance of the external source input — 50 Ω or 100 kΩ.

Parameters: <CPD>

Valid values: Z50 | K100

*RST sets: Z50 (in SCPI mode) or K100 (in 202x emulation).

[SOURce][:MODulation]**:IQ:EXT**ernal**:IMP**edance?

Description: Queries the impedance of the external source input — 50 Ω or 100 kΩ.

Parameters: None

Response: <CRD>

Returned values: Z50 | K100

[SOURce][:MODulation]**:IQ:SOUR**ce

Description: Sets the IQ modulation source.

Parameters: <CPD>

Valid values: ARB | EXT

*RST sets EXT

[SOURce][:MODulation]**:IQ:SOUR**ce?

Description: Returns the IQ modulation source.

Parameters: None

Response: <CRD>

Returned values: ARB | EXT

[SOURce][:MODulation]**:IQ:STAT**e

Description: Turns the IQ path on or off.

Parameters: <Boolean>

Valid values: OFF | ON | 0 | 1

*RST sets: OFF

[SOURce][:MODulation]**:IQ:STAT**e?

Description: Queries whether the IQ path is on (1) or off (0).

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

Phase modulation commands

([SOURce][:MODulation]:PM subsystem)

Phase modulation deviation, source, frequency, waveshape, mod. sweep, phase, input parameters

Commands for:

- Setting phase modulation frequency and frequency step size
- Setting phase modulation deviation and deviation step size
- Setting phase modulation impedance and sensitivity
- Setting phase modulation mode (fixed or sweep)
- Setting phase modulation waveshape and time per sweep
- Setting phase modulation sweep parameters
- Setting internal/external source on/off
- Setting phase relationship of PM2 with respect to PM1.

```
[SOURce]
    [:MODulation]
        :PM[1]|2
            [:DEViation]\?
                :STEP
                    [:INCRement]\?
            :EXTernal
                :IMPedance\?
                :SENSitivity\?
            :INTernal
                :FREQuency\?
                    [:FIXed]
                        :STEP
                            [:INCRement]\?
                    :MODE\?
                    :SWEep
                        :DWELl\?
                        :MANual
                        :SPACing\?
                        :STARt\?
                        :STEP
                            [:LINear]\?
                            :LOGarithmic\?
                        :STOP\?
                :SHAPe\?
            :SOURce\?
            :STATe\?
        :PM2
            :INTernal
                :PHASe\?
                    :SENSitivity\?
```

[SOURce][:MODulation]**:PM**[1]|2[:DEViation]

Description: Sets the phase modulation deviation.

Parameters: <numeric_value>

Valid values: <NRf>(rad) | MAXimum | MINimum | UP | DOWN | RETurn | REFerence

Set by value, to maximum or minimum, stepping up or down, returning to the last full setting, or setting the current value to the last full setting.

*RST sets: MIN

[SOURce][:MODulation]**:PM**[1]|2[:DEViation]?

Description: Queries the phase modulation deviation.

Parameters: None

Response: <NR2>

Returned values: Phase modulation deviation in radians

[SOURce][:MODulation]**:PM**[1]|2[:DEViation]**:STEP**[:INCRement]

Description: Sets the phase modulation deviation step size.

Parameters: <numeric_value>

Valid values: <NRf>(rad) | MAXimum | MINimum

*RST sets: 0.1 rad

[SOURce][:MODulation]**:PM**[1]|2[:DEViation]**:STEP**[:INCRement]?

Description: Queries the phase modulation deviation step size.

Parameters: None

Response: <NR2>

Returned values: Phase modulation step size in radians

[SOURce][:MODulation]**:PM**[1]|2**:EXT**ernal**:IMP**edance

Description: Selects the impedance of the external source input — 50 Ω or 100 kΩ.

Parameters: <CPD>

Valid values: Z50 | K100

*RST sets: Z50 (in SCPI mode) or K100 (in 202x emulation).

[SOURce][:MODulation]**:PM**[1]|2**:EXT**ernal**:IMP**edance?

Description: Queries the impedance of the external source input — 50 Ω or 100 kΩ.

Parameters: None

Response: <CRD>

Returned values: Z50 | K100

[SOURce][:MODulation]**:PM**[1]|2**:EXT**ernal**:SENS**itivity

Description: Selects the sensitivity of the external source input for phase modulation — 1 V RMS or 1 V peak

Parameters: <CPD>

Valid values: VRMS | VPK

*RST sets: VRMS

[SOURce][:MODulation]**:PM**[1]|2**:EXT**ernal**:SENS**itivity?

Description: Queries the sensitivity of the external source input for phase modulation.

Parameters: None

Response: <CRD>

Returned values: VRMS | VPK

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency[:FIXed]

Description: Sets the internal phase modulation frequency.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum | UP | DOWN | RETurn | REFerence

Set by value, to maximum or minimum, stepping up or down, returning to the last full setting, or setting the current value to the last full setting.

*RST sets: PM1 = 1 kHz, PM2 = 400 Hz

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency[:FIXed]?

Description: Queries the internal phase modulation frequency.

Parameters: None

Response: <NR2>

Returned values: Phase modulation frequency in Hz

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency[:FIXed] **:STEP**[:INCRement]

Description: Set the internal phase modulation frequency step.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum

*RST sets: 10 Hz

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency[:FIXed] **:STEP**[:INCRement]?

Description: Queries the internal phase modulation frequency step size.

Parameters: None

Response: <NR2>

Returned values: Phase modulation frequency step size in Hz

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency**:MODE**

Description: Sets the mode of the phase modulation frequency operation.

Parameters: <CPD>

Valid values: FIXed | SWEep

*RST sets: FIXed

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency**:MODE**?

Description: Queries the mode of the phase modulation frequency operation (fixed or sweep).

Parameters: None

Response: <CRD>

Returned values: FIX | SWE

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:DWEL**l

Description: Sets the time per sweep step for phase modulation.

Parameters: <numeric_value>

Valid values: <NRf>(ms) | MAXimum | MINimum

*RST sets: 50 ms

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:DWEL**l?

Description: Queries the time per sweep step for phase modulation.

Parameters: None

Response: <NR2>

Returned values: Dwell time in ms

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:MAN**ual

Description: Sets a new phase modulation frequency whilst a sweep is paused.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum | UP | DOWN

Set by value, to maximum or minimum, or stepping up or down.

This command is available only when `PM[1]|2:INTernal:MODE SWEep` is selected, and sweep operation is not in progress (PAUSED or WAITING FOR TRIGGER). The frequency value should be limited to the range determined by `PM[1]|2:INTernal:SWEep:STARt` and `PM[1]|2:INTernal:SWEep:STOP`.

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:MAN**ual?

Description: Queries the phase modulation frequency set during a paused sweep.

Parameters: None

Response: <NR2>

Returned values: Phase modulation frequency in Hz

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:SPAC**ing

Description: Sets the mode of sweep spacing for phase modulation.

Parameters: <CPD>

Valid values: LINear | LOGarithmic

*RST sets: LIN

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:SPAC**ing?

Description: Queries the mode of sweep spacing for phase modulation.

Parameters: None

Response: <CRD>

Returned values: LIN | LOG

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STAR**t

Description: Sets the start frequency for the phase modulation sweep.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum

*RST sets: MIN

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STAR**t?

Description: Queries the start frequency for the phase modulation sweep.

Parameters: None

Response: <NR2>

Returned values: Phase modulation start frequency in Hz

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STEP**[:LINear]

Description: Sets the size of the step for linear phase modulation sweeps.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum

*RST sets: 1 kHz

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STEP**[:LINear]?

Description: Queries the size of the step for linear phase modulation sweeps.

Parameters: None

Response: <NR2>

Returned values: Linear sweep step size in Hz

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STEP:LOG**arithmic

Description: Sets the size of the step for logarithmic phase modulation sweeps as a percentage.

Parameters: <numeric_value>

Valid values: <NRf>(PCT) | MAXimum | MINimum

*RST sets: 1 PCT

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STEP:LOG**arithmic?

Description: Queries the size of the step for logarithmic phase modulation sweeps.

Parameters: None

Response: <NR2>

Returned values: Logarithmic sweep step size as a percentage

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STOP**

Description: Sets the stop frequency for the phase modulation sweep.

Parameters: <numeric_value>

Valid values: <NRf>(Hz) | MAXimum | MINimum

*RST sets: MAX

[SOURce][:MODulation]**:PM**[1]|2**:INT**ernal**:FREQ**uency**:SWE**ep **:STOP**?

Description: Queries the stop frequency for the phase modulation sweep.

Parameters: None

Response: <NR2>

Returned values: Phase modulation sweep stop frequency in Hz

[SOURce][:MODulation]:PM[1]|2:INTernal:SHAPe

Description: Selects the shape of the internally generated phase modulation.

Parameters: <CPD>

Valid values: SINE | SQUare | TRIangle | RAMP

*RST sets: SINE

[SOURce][:MODulation]:PM[1]|2:INTernal:SHAPe?

Description: Queries the shape of the internally generated phase modulation.

Parameters: None

Response: <CRD>

Returned values: SINE | SQU | TRI | RAMP

[SOURce][:MODulation]:PM[1]|2:SOURce

Description: Selects either an internal or external source to generate phase modulation.

Parameters: <CPD>

Valid values: INTernal | EXTernal

*RST sets: INT

[SOURce][:MODulation]:PM[1]|2:SOURce?

Description: Queries whether the source for phase modulation is internal or external.

Parameters: None

Response: <CRD>

Returned values: INT | EXT

[SOURce][:MODulation]:PM[1]|2:STATe

Description: Adds PM1 or PM2 to the set of active modulations, or removes PM1 or PM2 from it: see Fig. 4-1 on page 4-19.

Parameters: <Boolean>

Valid values: OFF | ON | 0 | 1

*RST sets: OFF

[SOURce][:MODulation]:PM[1]|2:STATe?

Description: Queries whether the phase modulation path is on (1) or off (0).

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

[SOURce][:MODulation]:PM2:INTernal:PHASe

Description: Sets the phase offset of PM2 relative to PM1.

Parameters: <numeric_value>

Valid values: <NRf> | UP | DOWN

*RST sets: 0

[SOURce][:MODulation]:PM2:INTernal:PHASe?

Description: Queries the phase offset of PM2 relative to PM1.

Parameters: None

Response: <NR2>

Returned values: Phase angle (degrees)

[SOURce][:MODulation]**:PM2:INT**ernal**:PHAS**e**:SENS**itivity

Description: Selects the sensitivity of the rotary control or (x10 ⇩) and (÷10 ⇧) keys when setting up the phase offset of PM2 relative to PM1.

Parameters: <CPD>

Valid values: FINe (0.01º resolution)
MEDium (0.1º resolution)
COARse (1.0º resolution)

*RST sets: FINe

[SOURce][:MODulation]**:PM2:INT**ernal**:PHAS**e**:SENS**itivity?

Description: Queries the sensitivity of the rotary control or (x10 ⇩) and (÷10 ⇧) keys when setting up the phase offset of PM2 relative to PM1.

Parameters: None

Response: <CRD>

Returned values: FIN | MED | COAR

Pulse modulation commands

([SOURce][:MODulation]:PULM subsystem)

Pulse modulation source, control

Commands for:

- Confirming pulse modulation source
- Turning pulse modulation on/off.

[SOURce]
[:MODulation]
:PULM
:SOURce\?
:STATe\?

[SOURce][:MODulation]**:PULM:SOUR**ce

Description: Sets the source that is to generate pulse modulation: this source can only be external.

Parameters: <CPD>

Valid values: EXTernal

*RST sets: EXT

[SOURce][:MODulation]**:PULM:SOUR**ce?

Description: Returns that the source for pulse modulation is external.

Parameters: None

Response: <CRD>

Returned values: EXT

[SOURce][:MODulation]**:PULM:STAT**e

Description: Adds Pulse to the set of active modulations, or removes Pulse from it: see Fig. 4-1 on page 4-19.

Parameters: <Boolean>

Valid values: OFF | ON | 0 | 1

*RST sets: OFF

[SOURce][:MODulation]**:PULM:STAT**e?

Description: Queries whether the Pulse path is off (0) or on (1).

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

Level-handling commands

([SOURce]:POWer subsystem)

ALC, attenuator locking, carrier level, carrier level sweeping, level steps, offsets, max. RF level

Commands for:

- Configuring the ALC's bandwidth and state
- Setting attenuator locking on/off
- Setting carrier level and step size
- Setting compensation for external losses (offsets)
- Setting an RF output limit
- Setting sweep parameters.

```
[SOURce]
    :POWer
        :ALC
            :BW\?
            [:STATe]\?
        [:LEVel]
            :ATTenuation
                :AUTO]\?
            [:IMMediate]
                [:AMPlitude]\?
                    :OFFSet
                        :ATTenuation\?
                        [:GAIN]\?
                        :LOSS\?
                        :STATe\?
                    :STEP
                        [:Increment]\?
        :LIMit
            [:AMPLitude]\?
        :MODE\?
        :SWEep
            :DWELl\?
            :MANual\?
            :STARt\?
            :STEP\?
            :STOP\?
```

[SOURce]:POWer:ALC:BW

Description: Sets the ALC bandwidth for optimum performance.

Parameters: <CPD>

Valid values: AUTO | MODerate | NARRow | BROad

*RST sets: AUTO

[SOURce]:POWer:ALC:BW?

Description: Returns the ALC bandwidth setting.

Parameters: None

Response: <CRD>

Returned values: AUTO | MODerate | NARR | BRO

[SOURce]:POWer:ALC[:STATe]

Description: Sets the ALC state for optimum performance.

Parameters: <CPD>

Valid values: AUTO | NORMal | AM | FROZen | SCALed

*RST sets: NORMal

[SOURce]:POWer:ALC[:STATe]?

Description: Returns the ALC state.

Parameters: None

Response: <CRD>

Returned values: AUTO | NORM | AM | FROZ | SCAL

[:SOURce]:POWer[:LEVel]:ATTenuation:AUTO

Description: Turns the attenuator locking on and off.

Parameters: <Boolean>

Valid values: OFF | ON | 0 | 1

*RST sets: OFF

[:SOURce]:POWer[:LEVel]:ATTenuation:AUTO?

Description: Queries whether the attenuator lock is off (0) or on (1).

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

[SOURce]:POWer[:LEVel][:IMMediate][:AMPlitude]

Description: Sets the carrier level.

Parameters: <numeric_value>

Valid values: <NRf> | MAXimum | MINimum | UP | DOWN | RETurn | REFerence

Set by value, to maximum or minimum, stepping up or down, returning to the last full setting, or setting the current value to the last full setting.

<NRf> is in units set by `:UNIT:POW` or `:UNIT:VTYP` on page 4-114.

*RST sets: MIN

[SOURce]:POWer[:LEVel][:IMMediate][:AMPlitude]?

Description: Queries the carrier level by value.

Parameters: None

Response: <NR2>

Returned values:

[SOURce]**:POW**er[:LEVel][:IMMediate][:AMPlitude]**:OFFS**et **:ATT**enuation

Description: Sets the external attenuation value for power offset.

Note that gain, attenuation and system loss are added together to give the overall offset.

Actual RF output power = displayed RF level – gain value + attenuation value + system loss value.

Parameters: <numeric_value>

Valid values: <NRf>(dB) | MINimum | MAXimum

*RST sets: 0 dB

[SOURce]**:POW**er[:LEVel][:IMMediate][:AMPlitude]**:OFFS**et **:ATT**enuation?

Description: Returns the external attenuation value for power offset.

Parameters: None

Response: <NR2>

Returned values: Attenuation level (dB)

[SOURce]**:POW**er[:LEVel][:IMMediate][:AMPlitude]**:OFFS**et[:GAIN]

Description: Sets the external gain value for power offset.

Note that gain, attenuation and system loss are added together to give the overall offset.

Actual RF output power = displayed RF level – gain value + attenuation value + system loss value.

Parameters: <numeric_value>

Valid values: <NRf>(dB) | MINimum | MAXimum

*RST sets: 0 dB

[SOURce]**:POW**er[:LEVel][:IMMediate][:AMPlitude]**:OFFS**et[:GAIN]?

Description: Returns the external gain value for power offset.

Parameters: None

Response: <NR2>

Returned values: Gain level (dB)

[SOURce]:POWer[:LEVel][:IMMediate][:AMPlitude]:OFFSet:LOSS

Description: Sets the external system loss value for power offset.

Note that gain, attenuation and system loss are added together to give the overall offset.

Actual RF output power = displayed RF level – gain value + attenuation value + system loss value.

Parameters: <numeric_value>

Valid values: <NRf>(dB) | MINimum | MAXimum

*RST sets: 0 dB

[SOURce]:POWer[:LEVel][:IMMediate][:AMPlitude]:OFFSet:LOSS?

Description: Returns the external system loss value for power offset.

Parameters: None

Response: <NR2>

Returned values: Loss level (dB)

[SOURce]:POWer[:LEVel][:IMMediate][:AMPlitude]:OFFSet:STATe

Description: Sets the carrier level offset on or off.

Parameters: <Boolean>

Valid values: OFF | ON | 0 | 1

*RST sets: OFF

[SOURce]:POWer[:LEVel][:IMMediate][:AMPlitude]:OFFSet:STATe?

Description: Queries whether the carrier level offset is off (0) or on (1).

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

[SOURce]:POWer[:LEVel][:IMMediate][:AMPlitude]:STEP[:Increment]

Description: Sets the step size for carrier level.

Parameters: <numeric_value>

Valid values: <NRf>(dB) | MAXimum | MINimum

*RST sets: 1 dB

[SOURce]:POWer[:LEVel][:IMMediate][:AMPlitude]:STEP[:Increment]?

Description: Queries the step size for carrier level.

Parameters: None

Response: <NR2>

Returned values: Carrier level step size in dB

[SOURce]:POWer:LIMit[:AMPLitude]

Description: Sets the maximum RF level limit.

Parameters: <numeric_value>

Valid values: <NRf>(dB) | MAXimum | MINimum

*RST sets: MAX

[SOURce]:POWer:LIMit[:AMPLitude]?

Description: Queries the maximum RF level limit.

Parameters: None

Response: <NR2>

Returned values: Power level limit, in the units set on page 4-114

[SOURce]:POWer:MODE

Description: Sets the mode of the carrier level operation.

Parameters: <CPD>

Valid values: FIXed | SWEep

*RST sets: FIX

[SOURce]:POWer:MODE?

Description: Returns the mode of carrier level operation.

Parameters: None

Response: <CRD>

Returned values: FIX | SWE

[SOURce]:POWer:OPTimisation

Description: Sets RF power optimization by selecting the appropriate noise mode.

Parameters: <CPD>

Valid values: AUTO | POWer | NOise | ACP

AUTO sets the optimum mode automatically, depending on RF level.
POW sets the maximum possible output power.
NO optimizes the output level for low noise.
ACP optimizes the output level for low ACP.

*RST sets: AUTO

[SOURce]:POWer:OPTimisation?

Description: Queries the RF power optimization.

Parameters: None

Response: <CRD>

Returned values: AUTO | POW | NO | ACP

Example:

[SOURce]:POWer:SWEep:DWELl

Description: Sets the time per sweep step for carrier level.

Parameters: <numeric_value>

Valid values: <NRf>(ms) | MAXimum | MINimum

*RST sets: 50 ms

[SOURce]:POWer:SWEep:DWELl?

Description: Queries the time per sweep step for carrier level.

Parameters: None

Response: <NR2>

Returned values: Time per sweep step in ms

[SOURce]:POWer:SWEep:MANual

Description: Sets the output power sweep level.

Parameters: <numeric_value>

Valid values: <NRf>(dB) | MAXimum | MINimum | UP | DOWN

Set by value, to maximum or minimum, or stepping up or down.

<level> is in units set by `:UNIT:POW` or `:UNIT:VTYP` on page 4-114.

[SOURce]:POWer:SWEep:MANual?

Description: Queries the value of the output power sweep level.

Parameters: None

Response: <NR2>

Returned values: Power level, in the units set on page 4-114

[SOURce]:POWer:SWEep:STARt

Description: Sets the start level for a power sweep.

Parameters: <numeric_value>

Valid values: <NRf>(dB) | MAXimum | MINimum

*RST sets: MIN

[SOURce]:POWer:SWEep:STARt?

Description: Queries the start level for a power sweep.

Parameters: None

Response: <NR2>

Returned values: Start level, in the units set on page 4-114

[SOURce]:POWer:SWEep:STEP

Description: Sets the step level for a power sweep.

Parameters: <numeric_value>

Valid values: <NRf>(dB) | MAXimum | MINimum

*RST sets: MAX

[SOURce]:POWer:SWEep:STEP?

Description: Queries the step level for a power sweep.

Parameters: None

Response: <NR2>

Returned values: Step level, in the units set on page 4-114

[SOURce]:POWer:SWEep:STOP

Description: Sets the stop level for a power sweep.

Parameters: <numeric_value>

Valid values: <NRf>(dB) | MAXimum | MINimum

*RST sets: MAX

[SOURce]:POWer:SWEep:STOP?

Description: Queries the final level for a power sweep.

Parameters: None

Response: <NR2>

Returned values: Stop level, in the units set on page 4-114

Sweep commands

([SOURce]:SWEep subsystem)

Sweep handling and triggering

Commands for:

- Controlling operation of a frequency or power sweep
- Setting the sweep trigger mode.

[SOURce]
:SWEep
:ABORt
:CONTinue
:INITiate
:OPERation\?
:PAUSe
:RESet
:TRIGger\?

[SOURce]**:SWE**ep**:ABOR**t

Description: Stops the sweep immediately.

Parameters: None

[SOURce]**:SWE**ep**:CONT**inue

Description: Continues a paused sweep.

Parameters: None

[SOURce]**:SWE**ep**:INIT**iate

Description: Starts a sweep.

Parameters: None

[SOURce]:SWEep:OPERation

Description: Sets whether the sweep mode is single or continuous.

Parameters: <CPD>

Valid values: SINGle | CONTinuous

*RST sets: SING

[SOURce]:SWEep:OPERation?

Description: Returns whether the sweep mode is single or continuous.

Parameters: None

Response: <CRD>

Returned values: SING | CONT

[SOURce]:SWEep:PAUSe

Description: Pauses the sweep.

Parameters: None

[SOURce]:SWEep:RESet

Description: Resets the sweep to its starting value of power or frequency.

Parameters: None

[SOURce]:SWEep:TRIGger

Description: Sets the trigger mode to off, start, start then stop, or step.

Parameters: <CPD>

Valid values: OFF | STARt | SSTOP | STEP

*RST sets: OFF

[SOURce]:SWEep:TRIGger?

Description: Queries the trigger mode for the sweep.

Parameters: None

Response: <CRD>

Returned values: OFF | STAR | SSTOP | STEP

Instrument system-level commands

(SYSTem subsystem)

GPIB address, RS-232 setup, error queue, keyboard locking, SCPI/2023 commands, power-up and memory handling, touch screen on/off, SCPI version

Commands for:

- Setting the instrument's GPIB address, baud rate and serial interface parameters
- Setting keyboard locking
- Setting the default command set
- Setting power-on memory location parameters
- Setting the default store locations for save/recall operations

```
SYSTem
    :COMMunicate
        :GPIB
            [:SELF]
                :ADDRess\?          GPIB address
        :REMote\?
        :SERial                     RS-232 setup
            :BAUD\?
            :CONTrol
                :HANDshake\?
            :PARity
                :[TYPE]\?
            :SBITs\?
    :ERRor
        :ALL?
        :CODE
            :ALL?
            [:NEXT]?
        :COUNt?
        [:NEXT]?
    :HELP
        HEADers?
    :KLOCk\?                        Keyboard locking
    :LANGuage\?                     SCPI or 2023 commands
    :PON
        :MEMory\?                   Power-on memory store
        :TYPE\?                     Power-on memory location
    :PRESet
    :SETTings
        :FULL
            :CLEar
                :ALL
            :RECALL
            :SAVE
```

SYSTem:COMMunicate**:GPIB**[:SELF]**:ADDR**ess

Description: Sets the instrument's GPIB address.

This command is only actioned once the EOM at the end of the message has been received and all outstanding query responses have been read.

Parameters: <numeric_value>

Valid values: Valid GPIB address

*RST sets: No effect on the GPIB address set

SYSTem**:COMM**unicate**:GPIB**[:SELF]**:ADDR**ess?

Description: Returns the instrument's GPIB address.

Parameters: None

Response: <NR1>

Returned values: Integer

SYSTem**:COMM**unicate**:REM**ote

Description: Selects the remote operation interface.

This command is only actioned once the EOM at the end of the message has been received and all outstanding query responses have been read.

Parameters: <CPD>

Valid values: GPIB | RS232

*RST sets: No effect

SYSTem**:COMM**unicate**:REM**ote?

Description: Returns the remote operation interface that the instrument uses.

Parameters: None

Response: <CRD>

Returned values: GPIB | RS232

SYSTem:COMMunicate:SERial:BAUD

Description: Sets the baud rate of the serial interface.

This command is only actioned once the EOM at the end of the message has been received and all outstanding query responses have been read.

Parameters: <numeric_value>

Valid values: 300 | 600 | 1200 | 2400 | 4800 | 9600

*RST sets: No effect on the set baud rate.

SYSTem:COMMunicate:SERial:BAUD?

Description: Returns the baud rate of the serial interface.

Parameters: None

Response: <NR1>

Returned values: 300 | 600 | 1200 | 2400 | 4800 | 9600

SYSTem:COMMunicate:SERial:CONTrol:HANDshake

Description: Sets the serial interface's handshake protocol.

This command is only actioned once the EOM at the end of the message has been received and all outstanding query responses have been read.

Parameters: <CPD>

Valid values: OFF | HW | SW | BOTH

*RST sets: No effect on the handshake set.

SYSTem:COMMunicate:SERial:CONTrol:HANDshake?

Description: Returns the serial interface's hardware handshake.

Parameters: None

Response: <CRD>

Returned values: OFF | HW | SW | BOTH

SYSTem:COMMunicate:SERial:PARity:[TYPE]

Description: Sets the serial interface's parity type.

This command is only actioned once the EOM at the end of the message has been received and all outstanding query responses have been read.

Parameters: <CPD>

Valid values: EVEN | ODD | NONE

*RST sets: No effect on the parity type set.

SYSTem:COMMunicate:SERial:PARity:[TYPE]?

Description: Returns the serial interface's parity type.

Parameters: None

Response: <CRD>

Returned values: EVEN | ODD | NONE

SYSTem:COMMunicate:SERial:SBITs

Description: Sets the number of stop bits that the serial interface uses.

This command is only actioned once the EOM at the end of the message has been received and all outstanding query responses have been read.

Parameters: <numeric_value>

Valid values: 1 | 2

*RST sets: No effect on the number of stop bits set.

SYSTem:COMMunicate:SERial:SBITs?

Description: Returns the number of stop bits that the serial interface uses.

Parameters: None

Response: <NR1>

Returned values: 1 | 2

SYSTem:ERRor:ALL?

Description: Queries the error queue for all unread items, and removes them from the queue.

Parameters: None

Response: <NR1>,<CRD>

Returns a comma-separated list of number,string pairs in FIFO order. If the queue is empty, the response is *0,'No error'*.

SYSTem:**ERR**or:**CODE**[:ALL]?

Description: Queries the error queue for all unread items, and removes them from the queue.

Parameters: None

Response: <NR1>,...,<NR1>

Returns a comma-separated list of only the error/event code numbers in FIFO order. If the queue is empty, the response is *0*.

SYSTem:**ERR**or:**CODE**[:NEXT]?

Description: Queries the error queue for the next item, and removes it from the queue.

Parameters: None

Response: <NR1>

Returns the error code only, as an integer. If the queue is empty, the response is *0*.

SYSTem:**ERR**or:**COUN**t?

Description: Queries the error queue for the number of unread items.

Parameters: None

Response: <NR1>

If the queue is empty, the response is *0*.

SYSTem:**ERR**or[:NEXT]?

Description: Queries the error queue for the next unread item, and removes it from the queue.

Parameters: None

Response: <NR1>,<CRD>

Returns a number and string. If the queue is empty, the response is *0,'No error'*.

SYSTem:**HELP**:**HEAD**ers?

Description: Returns a list of the instrument command headers.

Parameters: None

Response: <arbitrary block response data>

SYSTem:KLOCk

Description: Locks and unlocks the keyboard. When the keyboard is locked, the 0 RPP Reset soft box and the [LOCAL] key still function.

Parameters: <Boolean>

Valid values: ON | OFF | 1 | 0

*RST sets: OFF

SYSTem:KLOCk?

Description: Queries whether the keyboard is locked (1) or unlocked (0).

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

SYSTem:LANGuage

Description: Configures the instrument to function with either the SCPI-like command set or the 2023 command set and status reporting.

This command is only actioned once the EOM at the end of the message has been received and all outstanding query responses have been read.

Follow any change of language with `*RST` to clear status registers.

Parameters: <CPD>

Valid values: SCPI | IFR2023

*RST sets: No effect on the language set.

SYSTem:LANGuage?

Description: Returns the command set that the instrument is to work with.

Parameters: None

Response: <CRD>

Returned values: SCPI | IFR2023

SYSTem:PON:MEMory

Description: Specifies a user-defined power-on memory store number.

Parameters: <numeric_value>

Valid values: Valid store number.

*RST sets: No effect on the store number set.

SYSTem:PON:MEMory?

Description: Returns the power-on memory number.

Parameters: None

Response: <NR1>

Returned values: Store number.

SYSTem:PON:TYPE

Description: Selects power-on either from the default memory location (factory-preset) or one specified by `:SYSTem:PON:MEMory` above.

Parameters: <CPD>

Valid values: DEFault | MEMory

*RST sets: No effect on the language set.

SYSTem:PON:TYPE?

Description: Queries whether the instrument powers up from the default memory location or one specified by `:SYSTem:PON:MEMory` above.

Parameters: None

Response: <CRD>

Returned values: DEF | MEM

SYSTem:PRESet

Description: Returns the instrument to its default state (page 3-112).

Parameters: None

SYSTem:SETTings:FULL:CLEar:ALL

Description: Clears all user-defined memory locations.

Parameters: none

SYSTem:SETTings:FULL:RECall

Description: Recalls the contents of the specified memory location.

Parameters: <numeric_value>

Valid values: Valid store number | UP | DOWN

SYSTem:SETTings:FULL:SAVE

Description: Save the current configuration to the memory location.

Parameters: <numeric_value>

Valid values: Valid store number.

Measurement unit commands

(UNIT subsystem)

Output level/voltage units

Commands for:

- Setting the units for output level
- Setting the voltage type for absolute/relative units.

:UNIT
:POWer\?
:VoltTYPe\?

UNIT:POWer

Description: Sets the units for the output level, for the remote interface only. Local measurement units remain as set on the instrument's front panel.

Parameters: <CPD>

Valid values: DBM | DBV | DBMV | DBUV | V | MV | UV |

*RST sets: DBM

UNIT:POWer?

Description: Queries the units used for output level.

Parameters: None

Response: <CRD>

Returned values: DBM | DBV | DBMV | DBUV | V | MV | UV |

UNIT:VoltTYPe

Description: Sets the voltage type to be used for absolute and relative voltage units: DBV, DBMV, DBUV, V, MV, UV.

Parameters: <CPD>

Valid values: PD | EMF

*RST sets: Has no effect.

UNIT:VoltTYPe?

Description: Queries the voltage type used for voltage units.

Parameters: None

Response: <CRD>

Returned values: PD | EMF

Calibration commands

(CALibration subsystem)

Most calibration commands are included in the Maintenance Manual, as they are likely to be used only at routine calibration intervals or after servicing. The following command may however be useful during everyday operation.

CALibration
:IQUSer
:ADJust

CALibration**:IQUS**er**:ADJ**ust

Description: Performs a user IQ calibration at the current settings.

Diagnostic commands

(DIAGnostic subsystem)

Attenuator count, RPP trip count, elapsed operating time, version and part numbers

Commands for:

- Counting the number of attenuator operations
- Counting the number of RPP operations
- Monitoring the total time of operation and elapsed time since a reset
- Checking the version and part number of the boot PROM
- Checking the versions of CPLD, control and data gate array for the ARB, driver and RF boards.

DIAGnostic	
:INFormation	
:BOOTrom	
:PNUMber?	Boot PROM part number
:VERSion?	Boot PROM version
:CCOunt	Cumulative count of...
:ATTenuator?	...number of attenuator operations
:PROTection?	...number of RPP trips
:EDEFinitions?	Define error messages
:ETIMe?	Operating time since last reset
:RESet	
:OTIMe?	Total operating time
:PLDevice	
:ARB	
:BOOT?	ARB boot CPLD version
:CONTrol?	ARB control gate array version
:DATA?	ARB data gate array version
:DRIVer	
:CPLD?	Driver board CPLD version
:FPGA?	Driver board gate array version
:RFBoard	
:CPLD?	RF board CPLD version
:FPGA?	RF board gate array version

DIAGnostic:INFormation:BOOTrom:PNUMber?

Description: Queries the part number of the boot PROM.

Parameters: None

Response <CRD>

Returned values: Part number as a string.

DIAGnostic:INFormation:BOOTrom:VERSion?

Description: Queries the version number of the boot PROM.

Parameters: None

Response <CRD>

Returned values: Version number as a string.

DIAGnostic:INFormation:CCOunt:ATTenuator?

Description: Queries the cumulative total number of times that the mechanical attenuator has operated.

Parameters: None

Response <NR1>,<NR1>,<NR1>,<NR1>,<NR1>,<NR1>

Returned values: Number of operations of each attenuator pad.

DIAGnostic:INFormation:CCOunt:PROTection?

Description: Queries the number of times that the RPP has been activated since last reset.

Parameters: None

Response <NR1>

Returned values: Number of activations.

DIAGnostic:INFormation:EDEFinitions?

Description: Queries the error definitions, providing a listing of all possible current error messages.

Parameters: None

Response: <arbitrary block response data>

Returned values: List of errors in the format:

error type, error number, 'error description'

separated by line feeds.

DIAGnostic:**INF**ormation:**ETIM**e?

Description: Queries how much time has passed since the last reset (see :RESet below).

Parameters: None

Response: <NR2>

Returned values: Number of hours (fractional part in 15 min intervals: 0.25, 0.50, 0.75).

DIAGnostic:**INF**ormation:**ETIM**e:**RES**et

Description: Resets the elapsed time counter.

Parameters: None

DIAGnostic:**INF**ormation:**OTIM**e?

Description: Queries the total number of operating hours.

Parameters: None

Response: <NR2>

Returned values: Number of hours (fractional part in 15 min intervals: 0.25, 0.50, 0.75)

DIAGnostic:**INF**ormation:**PLD**evice:**ARB:BOOT**?

Description: Queries the version of the ARB's boot CPLD.

Parameters: None

Response: <NR1>

Returned values: Two hex. digits

DIAGnostic:**INF**ormation:**PLD**evice:**ARB:CONT**rol?

Description: Queries the version of the ARB's control gate array.

Parameters: None

Response: <NR1>

Returned values: Four hex. digits

DIAGnostic:**INF**ormation:**PLD**evice:**ARB:DATA**?

Description: Queries the version of the ARB's data gate arrays.

Parameters: None

Response: <NR1>

Returned values: Four hex. digits

DIAGnostic:**INF**ormation:**PLD**evice:**DRIV**er:**CPLD**?

Description: Queries the version of the driver board's CPLD.

Parameters: None

Response: <NR1>

Returned values: Four hex. digits

DIAGnostic:**INF**ormation:**PLD**evice:**DRIV**er:**FPGA**?

Description: Queries the version of the driver board's gate array.

Parameters: None

Response: <NR1>

Returned values: Four hex. digits

DIAGnostic:**INF**ormation:**PLD**evice:**RFB**oard:**CPLD**?

Description: Queries the version of the RF board's CPLD.

Parameters: None

Response: <NR1>

Returned values: Two hex. digits

DIAGnostic:**INF**ormation:**PLD**evice:**RFB**oard:**FPGA**?

Description: Queries the version of the RF board's gate array.

Parameters: None

Response: <NR1>

Returned values: Two hex. digits

Display commands

(DISPlay subsystem)

Screen blanking, contrast

Commands for:

- Blanking or unblanking different fields on the screen
- Setting display contrast.

DISPlay
- **:ANNotation** — Blanks all or selected (frequency/modulation/power) parts of display
  - **[:ALL]\?**
  - **:FREQuency\?**
  - **:MODulation\?**
  - **:POWer\?**
- **:CONTrast\?**

DISPlay:**ANN**otation[:ALL]

Description: Blanks or unblanks all the display parameters together: Carrier Freq, RF Level, Mod Depth and Deviations, and Mod Freq.

Parameters: <Boolean>

Valid values: ON | OFF | 1 | 0

*RST sets: ON

DISPlay:**ANN**otation[:ALL]?

Description: Queries if all the display parameters are blanked (0) or unblanked (1).

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

DISPlay:**ANN**otation:**FREQ**uency

Description: Blanks or unblanks the Frequency display.

Parameters: <Boolean>

Valid values: ON | OFF | 1 | 0

*RST sets: ON

DISPlay:**ANN**otation:**FREQ**uency?

Description: Queries if the Frequency display parameter is blanked (0) or unblanked (1).

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

DISPlay:ANNotation:MODulation

Description: Blanks or unblanks the Modulation display.

Parameters: <Boolean>

Valid values: ON | OFF | 1 | 0

*RST sets: ON

DISPlay:ANNotation:MODulation?

Description: Queries if the Modulation display parameter is blanked (0) or unblanked (1).

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

DISPlay:ANNotation:POWer

Description: Blanks or unblanks the RF Level display.

Parameters: <Boolean>

Valid values: ON | OFF | 1 | 0

*RST sets: ON

DISPlay:ANNotation:POWer?

Description: Queries if the RF Level display parameter is blanked (0) or unblanked (1).

Parameters: None

Response: <Boolean>

Returned values: 0 | 1

DISPlay**:CONT**rast

Description: Sets the contrast of the display.

Parameters: <numeric_value>

Valid values: 0 to 15 | MINimum | MAXimum

*RST sets: 8

DISPlay**:CONT**rast?

Description: Queries the contrast of the display.

Parameters: None

Response: <NR1>

Returned values: Display contrast setting, in the range 0 to 15

Status commands

(STATus subsystem)

Commands for determining the state of the instrument

Because the status subsystem consists of many similar registers, it would be repetitive to list the commands for each here. Instead, common commands and queries are given, with the universal **<StatReg>** representing individual registers.

STATus
- **<StatReg>**
  - **:CONDition?**
  - **:ENABle\?**
  - **:EVENt?**
  - **:NTRansition\?**
  - **:PTRansition\?**
- **:PRESet**

where **<StatReg>** is:

- **:OPERation**
- **:OPERation:TRIGger**
- **:QUEStionable**
- **:QUEStionable:CALibration**
- **:QUEStionable:FREQuency**
- **:QUEStionable:MODulation**
- **:QUEStionable:MODulation:AM**
- **:QUEStionable:MODulation:ARB**
- **:QUEStionable:MODulation:FM**
- **:QUEStionable:MODulation:IQ**
- **:QUEStionable:MODulation:PM**
- **:QUEStionable:MODulation:PULM**
- **:QUEStionable:POWer**
- **:QUEStionable:ROSCillator**

STATus:<StatReg>:CONDition?

Description: Reads the contents of the status register.

Parameters: None.

Response: <NR1>
Status register contents.

STATus:<StatReg>:ENABle

Description: Sets the enable mask, which allows true conditions in the status event register to be reported in the summary bit. If a bit is '1' in the enable register and its associated event bit makes a transition to true, a positive transition will occur in the associated summary bit.

Parameters: <NRf>
Mask

Valid values: 0–7FFFH

STATus:<StatReg>:ENABle?

Description: Reads the enable mask for the status register.

Parameters: [<NRf>]
[Mask]

Response: <NR1>
Mask

Returned values: 0–7FFFH

STATus:<StatReg>:EVENt?

Description: Reads the contents of the event register associated with the operation status register.

Parameters: None.

Response: <NR1>
Event register contents.

Returned values: 0–7FFFH

STATus:<StatReg>:NTRansition

Description: Sets the negative transition filter in the status register. Setting a bit in the negative transition filter causes a 1 to 0 transition in the corresponding bit of the associated condition register, causing a '1' to be written in the associated bit of the corresponding event register.

Parameters: <NRf>
Mask

Valid values: 0–7FFFH

STATus:<StatReg>:NTRansition?

Description: Reads the negative transition mask for the status register.

Parameters: [<NRf>]
[Mask]

Response: <NR1>
Mask

Returned values: 0–7FFFH

STATus:<StatReg>:PTRansition

Description: Sets the positive transition filter in the status register. Setting a bit in the positive transition filter causes a 0 to 1 transition in the corresponding bit of the associated condition register, causing a '1' to be written in the associated bit of the corresponding event register.

Parameters: <NRf>
Mask

Valid values: 0–7FFFH

STATus:<StatReg>:PTRansition?

Description: Reads the positive transition mask for the status register.

Parameters: [<NRf>]
[Mask]

Response: <NR1>
Mask

Returned values: 0–7FFFH

STATus:PRESet

Description: Sets the enable registers and transition filter registers to their preset conditions.

Parameters: None.

Status reporting

An instrument within a SCPI-based system contains a set of registers that reflect the current state of the instrument and whether a particular event has occurred. It is also sometimes necessary for an instrument to generate an alert if that condition exists or if that event has occurred.

The status registers contain information about the condition of the instrument. Using these registers, it is possible to find out, for example, whether an error has occurred with a command, if the local oscillator has locked, or if the external frequency standard is present. These registers can be used either by reading the contents directly when needed, or by configuring them to generate an interrupt signal (SRQ, service request) when the condition of interest occurs. The status system consists of readable ('questionable') registers, together with status, standard event and operation registers, as shown in Fig. 4-2. These registers are described below, and in greater detail on pages 4-133 onwards. Logic level '1' represents a set bit.

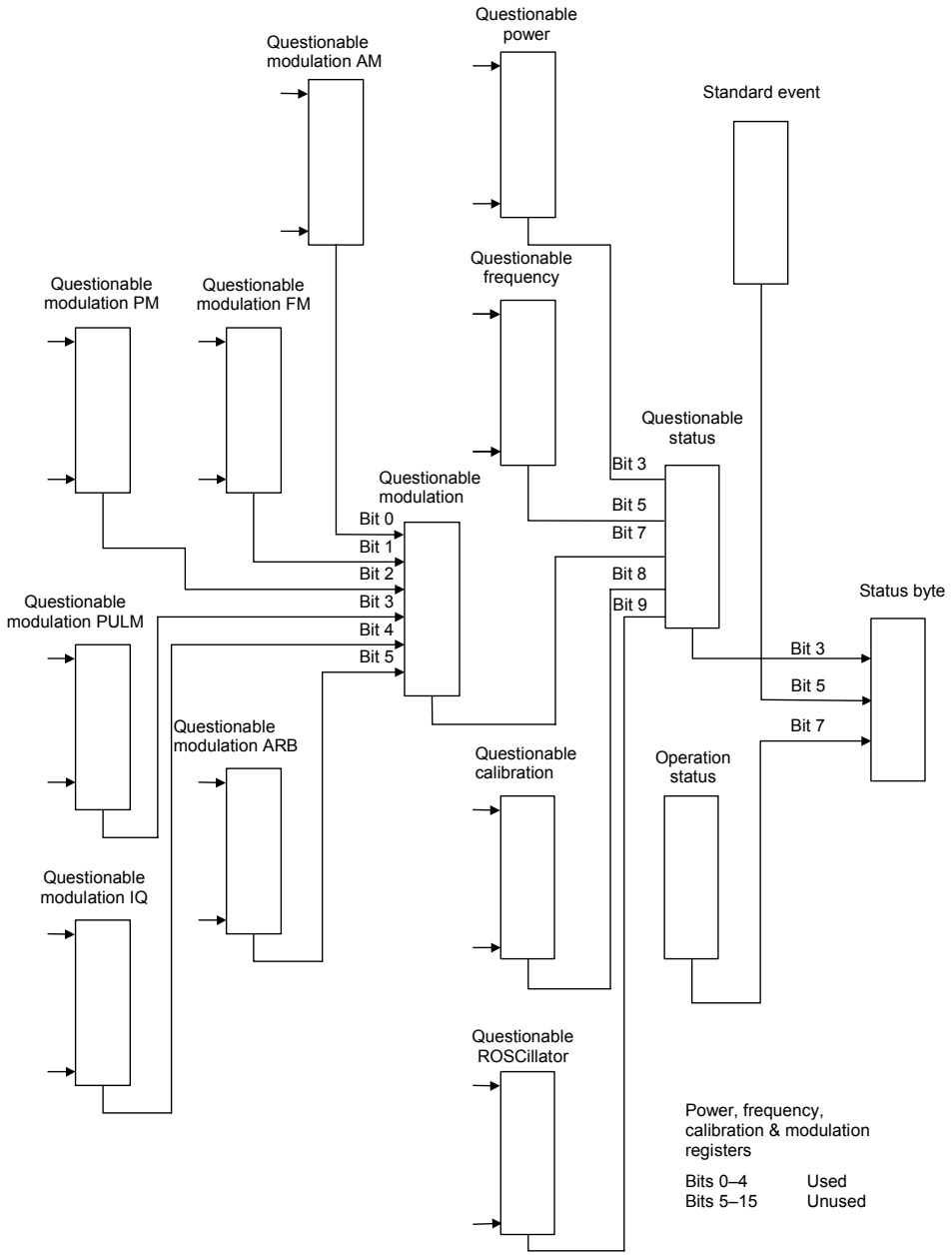


Fig. 4-2 Simplified status register structure

Status byte register. This 8–bit register (pages 4-133 and 4-134) is used to represent particular conditions or events in an instrument. The status byte register (defined by IEEE 488.1) is read by using the *STB? command or by serial poll. When read by serial poll, an SRQ (service request) is generated that alerts the controller. Associated with the status byte register is the service request enable register, which allows control over which bits of the status byte contribute towards the generation of the SRQ signal. When read by *STB?, bit 6 of the status byte is known as the *master summary status* function (MSS), and is the OR function of the other seven bits of the register.

Standard event register. This 8–bit register (page 4-137) extends the status reporting structure to cover various other events, defined by IEEE 488.2. The register is read by *ESR? The standard event enable register allows control over which bits of the standard event register affect the summary bit output (ESB). The summary bit is recorded in bit 5 of the status byte.

Operation status register. This 16–bit register (page 4-139), defined in SCPI, further extends the status reporting structure by providing information about what the instrument is doing. It is read by the STATus:OPERation:CONDition? or STATus:OPERation[:EVENt]? command. The summary bit output of the register is recorded in bit 7 of the status byte.

Questionable status register. This 16–bit register (page 4-138), defined in SCPI, gives information about factors affecting the quality of signal generation. It is read by the STATus:QUEStionable:CONDition? or STATus:QUEStionable[:EVENt]? command. The summary bit output of the register is recorded in bit 3 of the status byte.

Questionable power status register. This 16–bit register (page 4-139) further extends the questionable status register by providing power condition information. It is read by the STATus:QUEStionable:POWer:CONDition? or STATus:QUEStionable:POWer[:EVENt]? command and recorded in bit 3 of the questionable status register.

Questionable frequency status register. This 16–bit register (page 4-140) further extends the questionable status register by providing frequency condition information. It is read by the STATus:QUEStionable:FREQuency:CONDition? or STATus:QUEStionable:FREQuency[:EVENt]? command and recorded in bit 5 of the questionable status register.

Questionable modulation status register. This 16–bit register (pages 4-140 to 4-143) further extends the questionable status register by providing modulation condition information from the AM, FM, PM, PULM, IQ and ARB questionable modulation registers. It is read by the STATus:QUEStionable:MODulation:CONDition? or STATus:QUEStionable:MODulation[:EVENt]? command and recorded in bit 7 of the questionable status register.

Questionable calibration status register. This 16–bit register (page 4-144) further extends the questionable status register by providing calibration condition information. It is read by the STATus:QUEStionable:CALibration:CONDition? or STATus:QUEStionable:CALibration[:EVENt]? command and recorded in bit 8 of the questionable status register.

Questionable ROSCillator status register. This 16–bit register (page 4-143) further extends the questionable status register by providing reference oscillator condition information. It is read by the STATus:QUEStionable:ROSCillator:CONDition? or STATus:QUEStionable:ROSCillator[:EVENt]? command and recorded in bit 9 of the questionable status register.

The **output queue** (page 4-135) temporarily stores responses to query commands received by the instrument until they can be read by the controller. The **error queue** (page 4-135) temporarily stores up to 20 error messages. Each time the instrument detects an error, it places a message in the queue; each item contains an error number, defined in SCPI, and an error message. When the SYSTem:ERRor? query is sent, the message at the head of the error queue is moved to the output queue so it can be read by the controller.

Register structures

The operation and questionable register structures consist of condition, event, transition and enable registers.

The **condition registers** continuously monitor the instrument's hardware and firmware status. Bits in a condition register are not latched but are updated in real time (so that they represent the actual state of the instrument at all times) and are read by the above commands.

The bits of the **event registers** (read by STATus:OPERation:EVENt? and STATus:QUEStionable:EVENt?) are set on events. For example, the averaging bit in the operation register only indicates if the measurement is being performed with averaging enabled, while the associated event register shows that the averaging has completed.

A set of transition filters (**transition register**) control what type of change in a condition register will set the corresponding bit in the event register. The type of transition filter — negative, positive or both — is fixed for each bit. For example, the averaging bits in the operation register structure have negative transition filters so that the bits in the event register are set when averaging is complete. When the event register bits are set they remain set, even if the corresponding condition bits change. They are reset after being read by the query commands STATus:OPERation:EVENt? and STATus:QUEStionable :EVENt?, or when the *CLS (clear status) common command is issued. Transition registers are read–write, and are unaffected by query commands or *CLS.

The ability of each bit in the event registers to affect the summary bit in the status byte register can be enabled or disabled by corresponding bits in the event **enable registers**. These can be set and read by the commands/queries STATus:OPERation:ENABle\? and STATus:QUEStionable:ENABle\? The enabled bits are combined in a logical OR operation to produce the summary bit (summary bits are recorded in the instrument's status byte). Enable registers are cleared by *CLS.

The above status–reading commands return the decimal number equivalent of the register contents.

The events and conditions that are monitored by the instrument's status registers, and the commands for reading and writing to them, are described in more detail in 'Remote status reporting structure' on pages 4-133 and following.

Reading status information

As already stated, two techniques are used to interact with the status reporting structure:

Direct-read method. In many cases it is adequate and convenient for the controller simply to read the appropriate registers when necessary to determine the required status information. This technique does not involve the use of SRQ and therefore does not require any interrupt handling code in the application program. The following steps are used to monitor a condition:

Determine which register contains the bit that monitors the condition.

Send the query command that reads the register.

Examine the bit to see if the condition has changed.

The direct-read method works well when it is not necessary to know about changes the moment they occur. A program that uses this method to detect changes in a condition as soon as possible would need to continuously read the registers at very short intervals; the SRQ method is better suited to this type of need.

Service request (SRQ) method. In the SRQ method the instrument plays a more active role, in that it tells the controller when there has been a condition change without the controller asking. The following steps are required to monitor a condition:

Determine which register sets, and which of its bits monitors the condition.

Determine how that bit reports to the request service (RQS) bit of the status byte (some report directly while others may report indirectly through other register sets:).

Send remote commands to enable the bit that monitors the condition and to enable the summary bits that report the condition to the RQS bit.

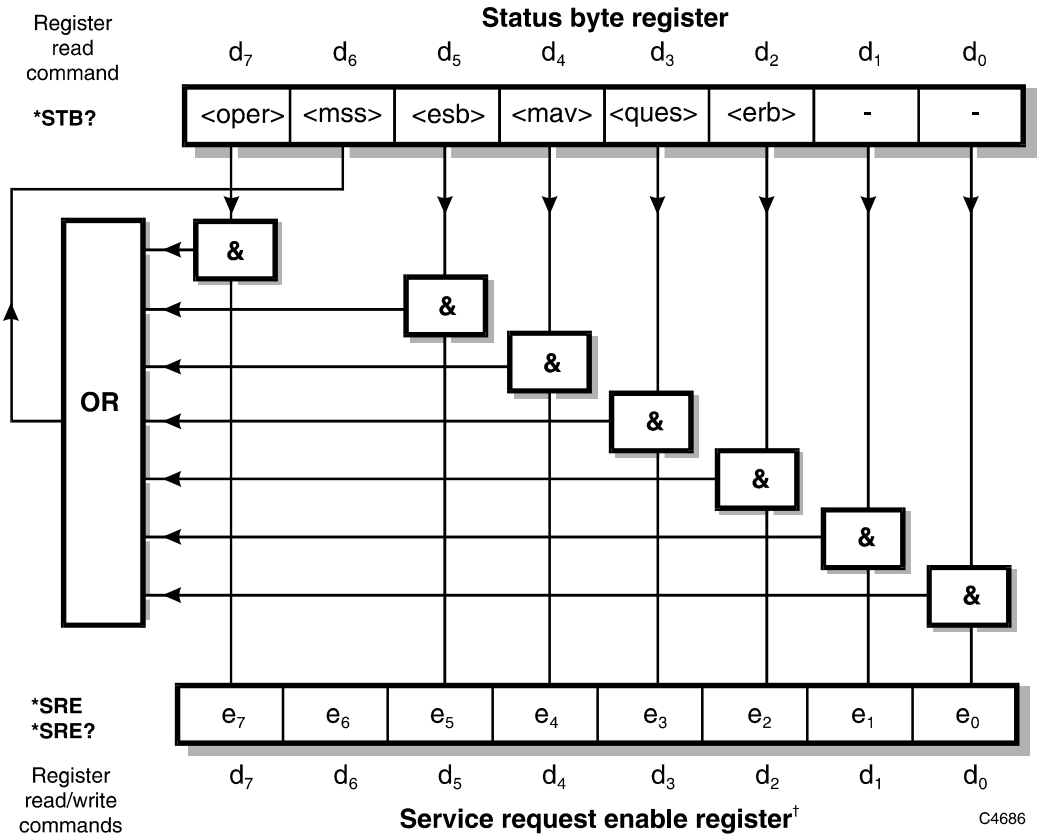
Enable the controller to respond to service requests.

When the condition changes, the instrument sets its RQS bit (bit 6) and the GPIB's SRQ line; the controller is informed of the change as soon as it occurs. Setting the SRQ line informs the controller that a device on the bus requires service. The program then instructs the controller to perform a serial poll; each device on the bus returns the contents of its status byte register in response to this poll. The device whose RQS bit is set to '1' is the device that requested service. After the status byte is read the RQS bit is reset to '0'; the other bits are not affected.

Another reason for using SRQ is the need to detect errors in the various devices within the instrument. Since the timing of errors may not be known in advance, and it is not practical for the program to check the status of every device frequently, an interrupt handling routine can be used to detect and investigate any SRQ generated.

Remote status reporting structure

Status byte when read by *STB?



† Bit 6 in this register ignores data sent by *SRE and always returns '0' in response to *SRE?

<rqs>, <esb> and <mav> are defined in IEEE 488.2.

<erb> is a device-defined queue summary bit, indicating that the error queue is non-empty (see 'Queue flag details' on page 4-135).

<mss> is true when (status byte) AND (enable register) > 0.

<esb> is the standard event register summary bit.

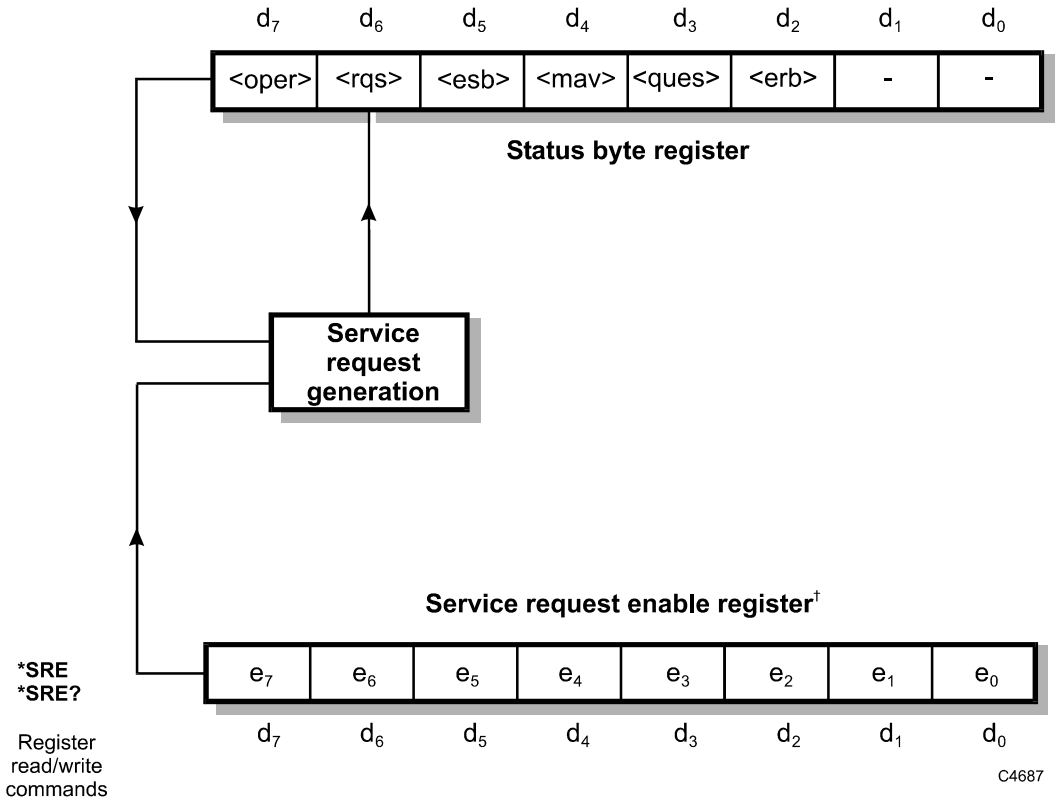
<mav> is 'message available', indicating that the output queue is non-empty (see 'Queue flag details' on page 4-135).

<oper> is the operation status register summary bit.

<ques> is the questionable status register summary bit.

Note: *the status byte register is not cleared by the *STB? query.*

Status byte when read by serial poll



† Bit 6 in this register ignores data sent by *SRE and always returns '0' in response to *SRE?

<rqs>, <esb> and <mav> are defined in IEEE 488.2.

<erb> is a device-defined queue summary bit, indicating that the error queue is non-empty.

<rqs> is set by request for service and is cleared by the poll.

<esb> is the standard event register summary bit.

<mav> is 'message available', indicating that the output queue is non-empty.

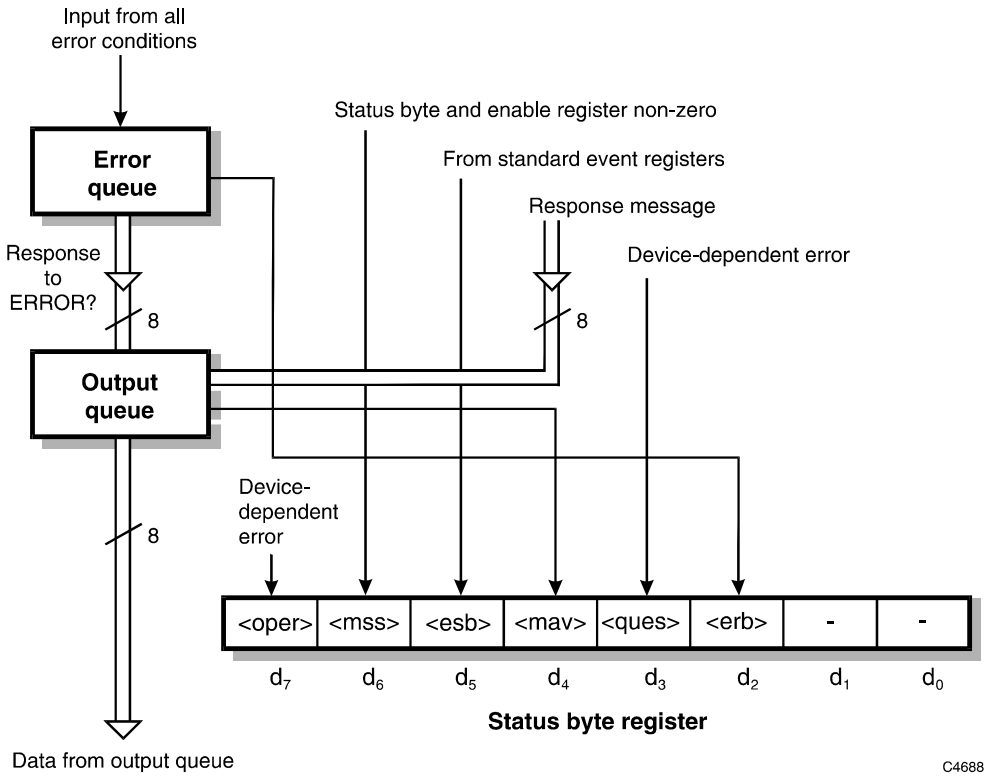
<oper> is the operation status register summary bit.

<ques> is the questionable status register summary bit.

<rqs> (request for service) produces an SRQ at the controller. It is set by a change to either the status byte or the service enable register that results in a new reason for service. It is cleared when <mss> goes FALSE (no reason for service) or by serial poll.

***Note**: the status byte register is not cleared by the *STB? query.*

Queue flag details

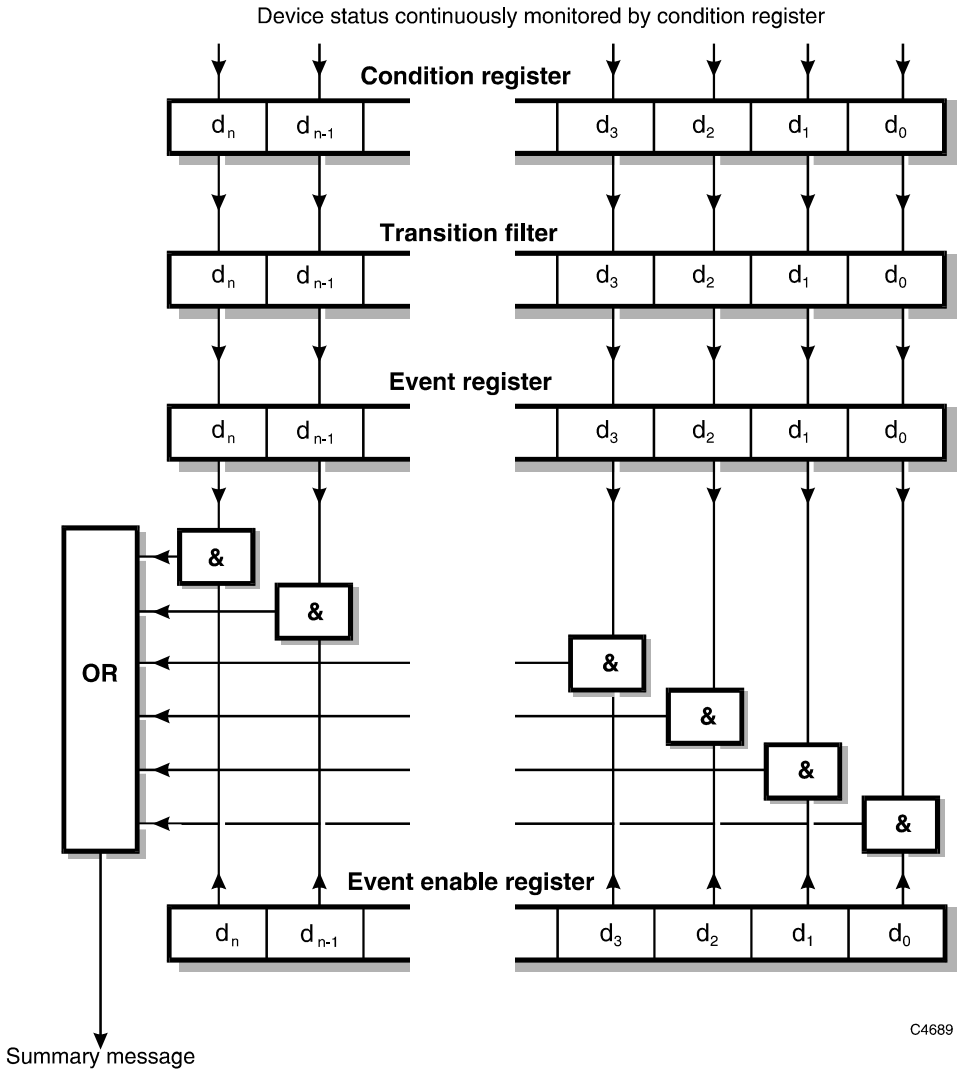


The <mav> status bit is set when one or more bytes are available to be read from the output queue.

The <erb> status bit is set when one or more errors are present in the error queue. The ERROR? query will place an NR1 response message in the output queue, representing the error at the head of the queue. If the queue is empty, this message is ‘0’.

Status data structure — register model

Below is a generalized model of the register set which funnels the monitored data into a single summary bit to set the appropriate bit in the status byte.



The condition register continuously monitors the device's status. If a query to read a condition register is provided, the response represents the status of the instrument at the moment the response is generated. A condition register cannot be written to.

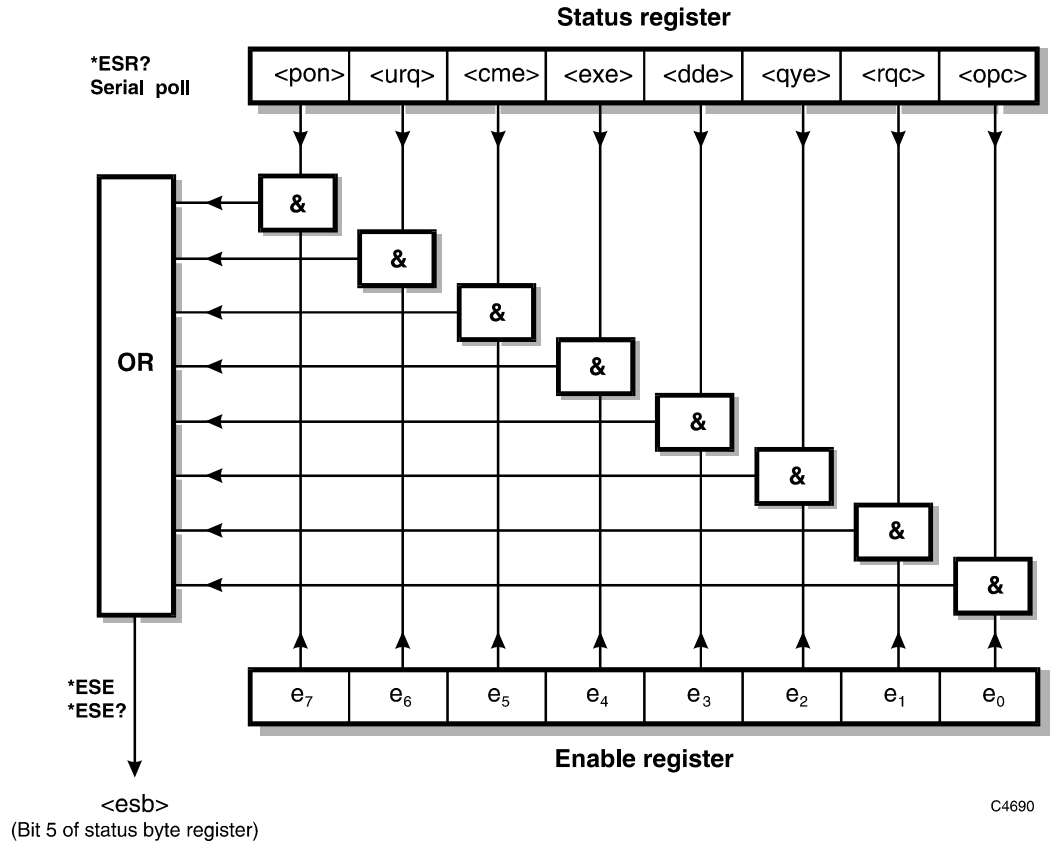
The transition filter determines which transition of the condition register data bits will set the corresponding bit in the event register. The condition register data bits are pre−set as either positive or negative.

The bits in an event register are 'latched'. Once set they remain set, regardless of subsequent changes in the associated condition bit until the event register is cleared by being read or by the *CLS common command. Once cleared, an event register bit will only be set again if the appropriate change in the condition bit occurs.

The event enable register may be both written to and read from. It is bitwise AND−ed with the event register and if the result is non−zero the summary message is true, otherwise the summary message is false. Enable registers are not affected by *CLS but are however clear at power−on.

Standard event register

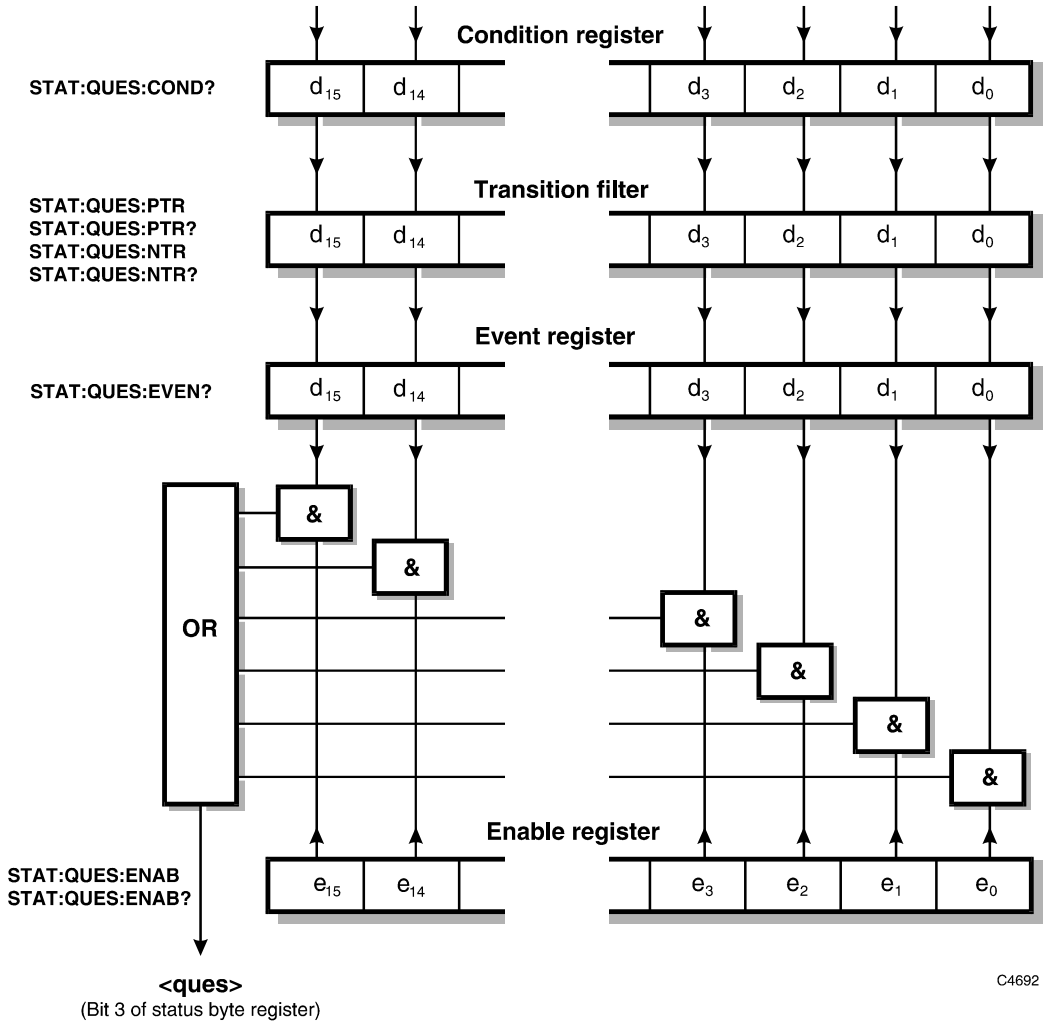
This register is defined by IEEE 488.2 and each bit has the meaning shown below:



<pon>	power on
<urq>	user request – not implemented in this instrument
<cme>	command error
<exe>	execution error
<dde>	device-dependent error
<qye>	query error
<rqc>	request control – not implemented in this instrument
<opc>	operation complete – set in response to the *OPC command for synchronization.
<esb>	standard event register summary bit

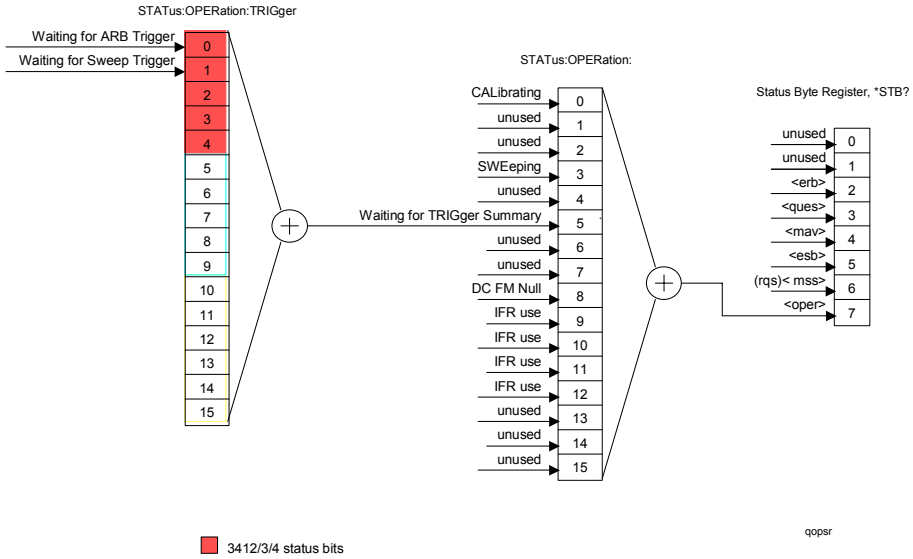
Questionable status register

This is a device-dependent register and the bits have meanings as shown below.

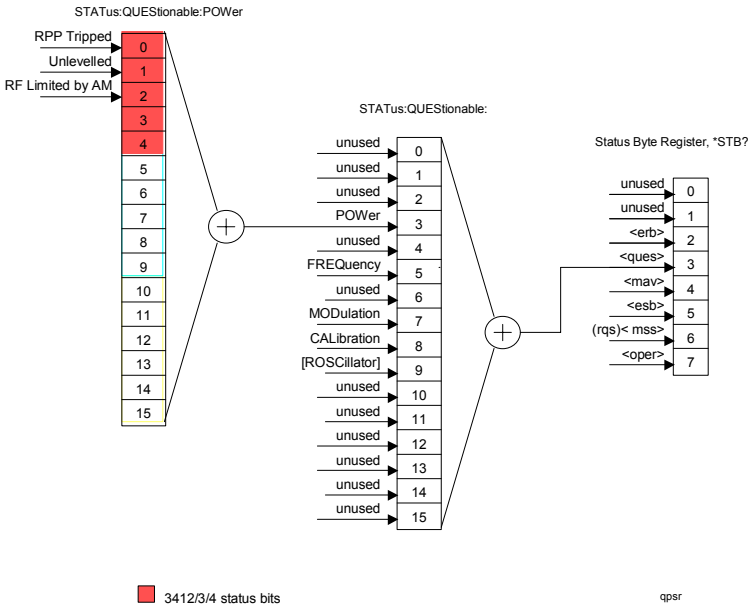


d0	–	d8	calibration required
d1	–	d9	oscillator
d2	–	d10	–
d3	power	d11	–
d4	–	d12	–
d5	frequency	d13	–
d6	–	d14	–
d7	–	d15	–

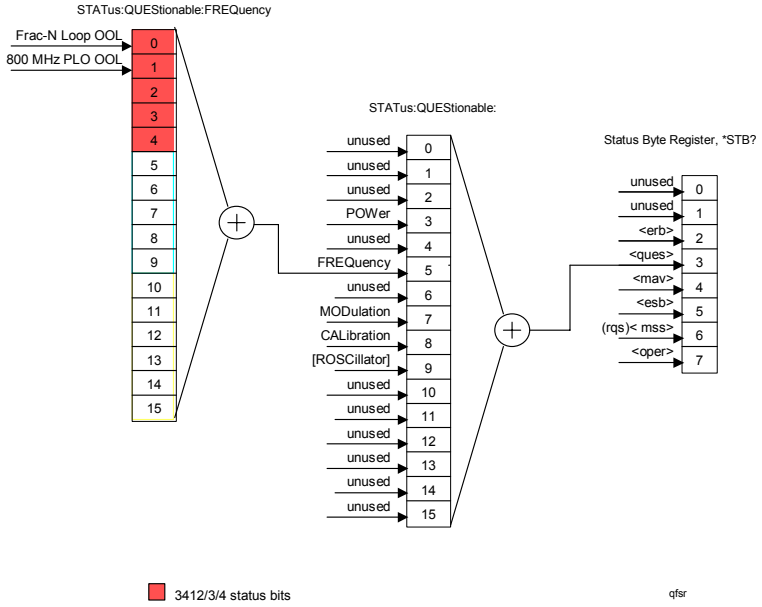
OPERation status register



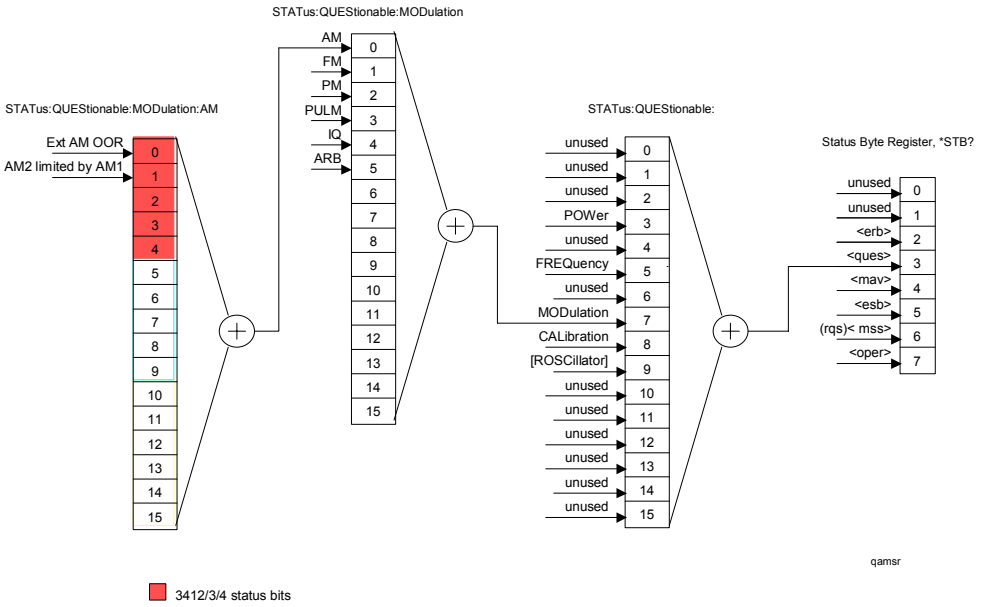
Questionable power status register



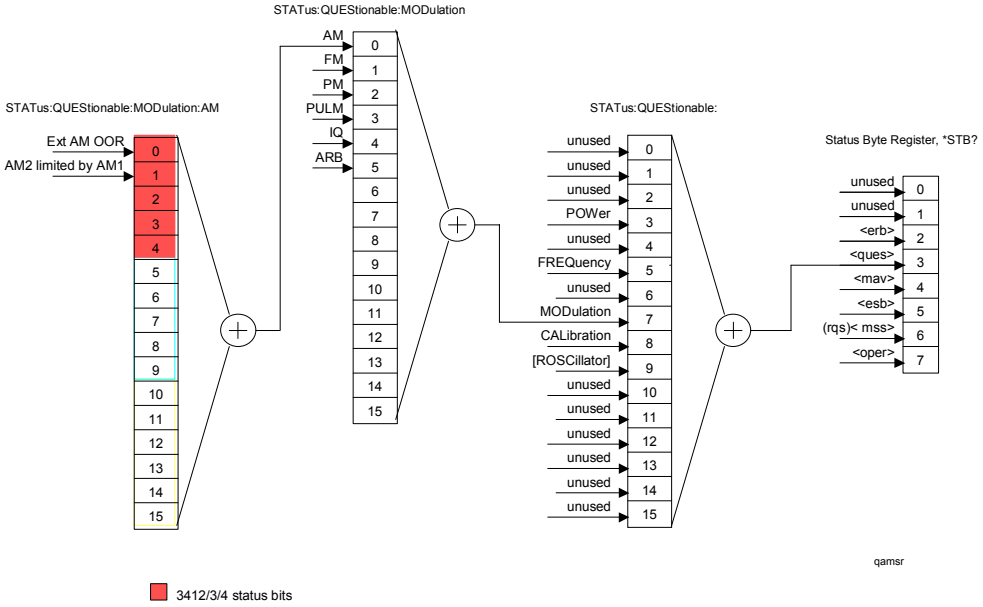
Questionable frequency status register



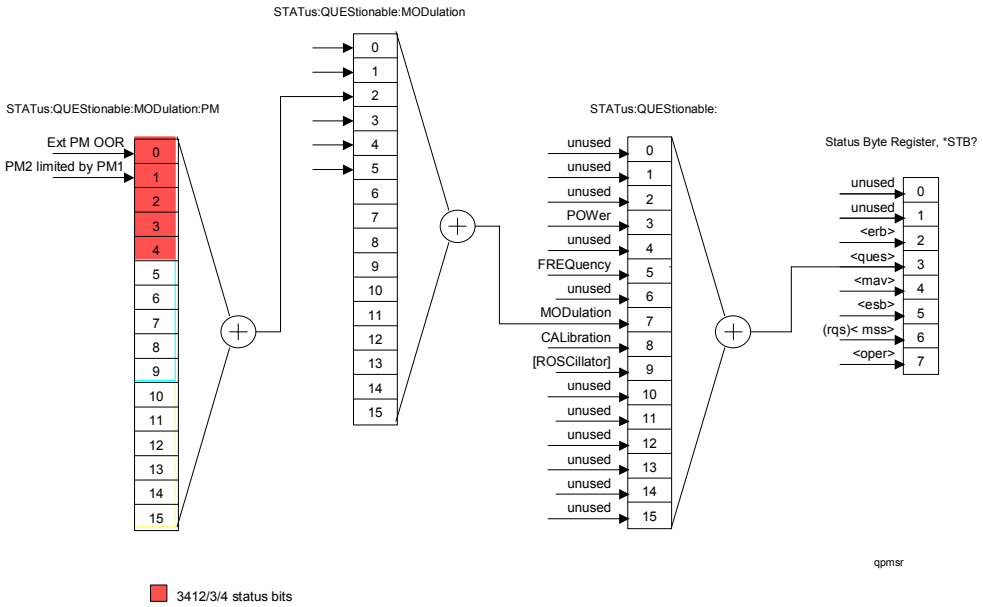
Questionable AM status register



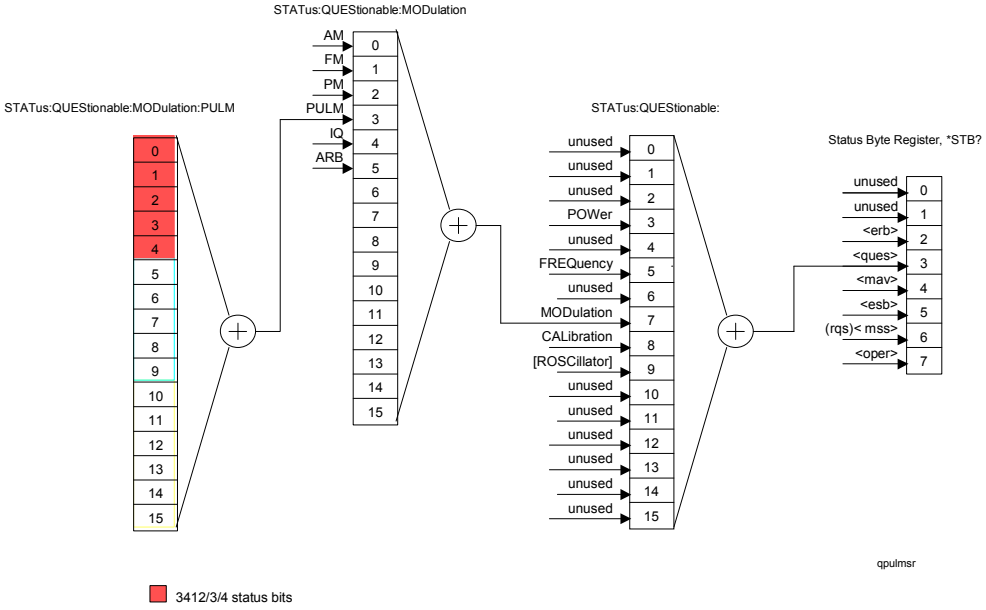
Questionable FM status register



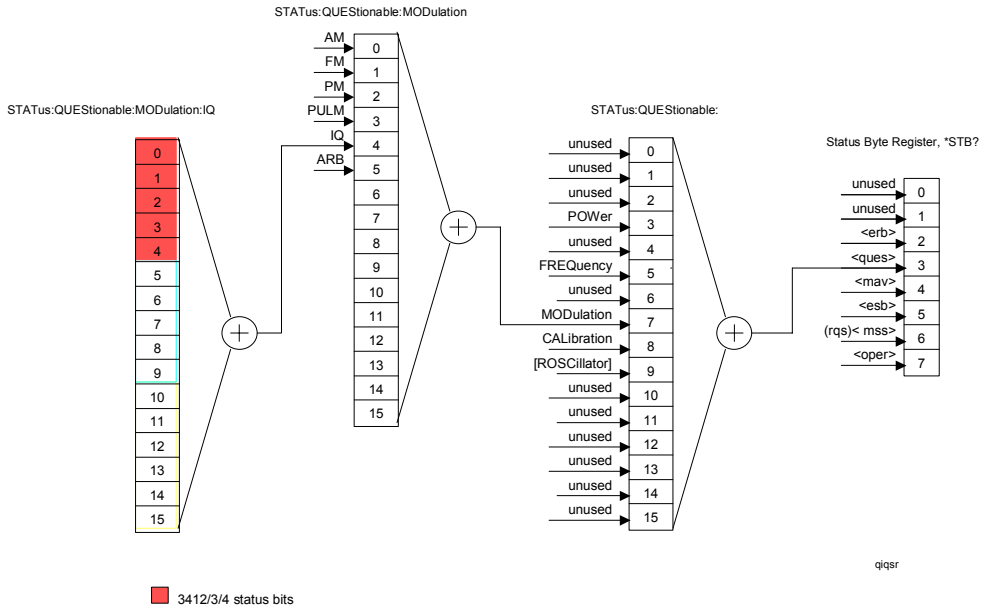
Questionable PM status register



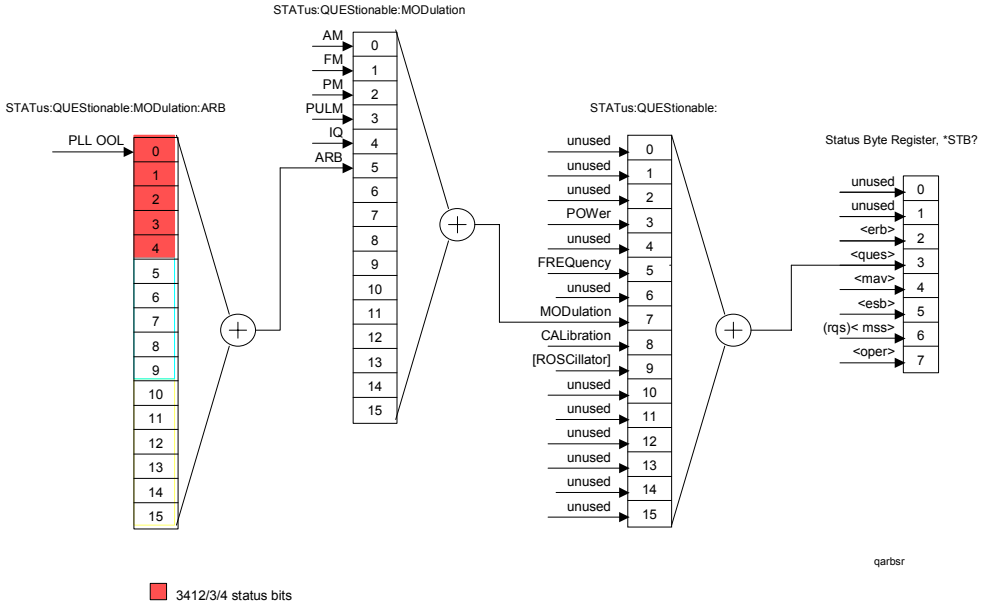
Questionable PULM status register



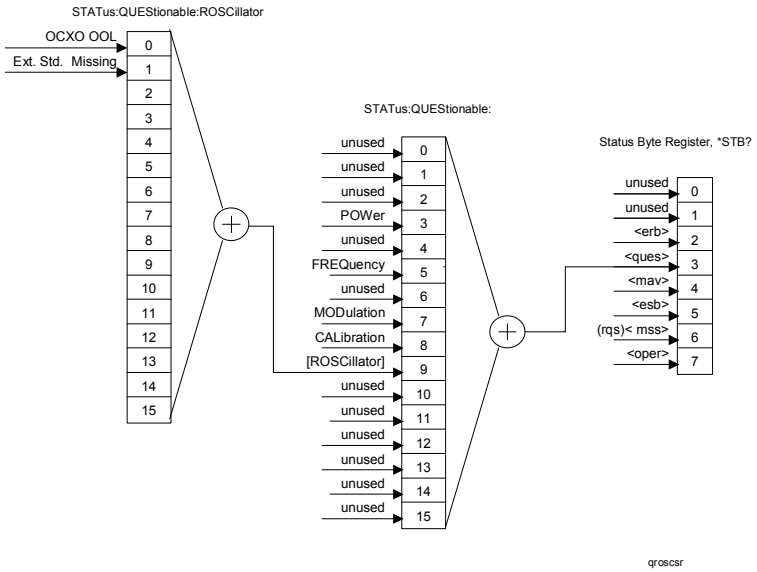
Questionable IQ status register



Questionable ARB status register



Questionable ROSCillator status register



Questionable CALibration status register